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ABSTRACT

This collection of instruction modules studies the interactions of science, technology, and society (STS) using five activity sets. The introduction module includes activities which show students the STS relationships in their world, develop good organizational skills, develop an understanding of who and what a scientist is, develop graphing skills, and aid in organizing data. Module 1 studies "the auto and energy" from a heat aspect. Activities include studies changing energy from one form to another, heat energy converted to mechanical energy, energy conversions (chemical to light), and making a thermistor. Module 2 examines "selecting your dream car." Student activities used are determining what the interior, exterior, and performance should be, costs of owning an automobile, and analyzing advertising methods in search of valid information. Module 3 stresses "transportation and your community." Skills developed include map making and reading, method of transportation and mileage, and the effects of different cars on gas usage. Module 4 covers "AUTO issues--the speed limit, seat belts, and you". Topics studied include local and national speed limits, fuel consumption and speed, and seatbelt safety. Each activity includes processes developed, instructional objectives, questions, materials and data, and a teacher evaluation form. In some modules, extras such as vocabulary words or word search games are included. (MVL)

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ED305239

The PITTS Project

INTRODUCTION MODULE

THE PITTSBURGH SCIENCE TECHNOLOGY SOCIETY PROJECT

INTERRELATIONSHIPS SCIENCE - TECHNOLOGY - SOCIETY

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THE PITTSBURGH SCIENCE TECHNOLOGY SOCIETY PROJECT

INTRODUCTION MODULE

INTERRELATIONSHIPS SCIENCE - TECHNOLOGY - SOCIETY

developed by

Inservice Workshop Participants

with the Primary Writing Team

June, 1988

George O'Brien, Project Director and Series Editor
University of Pittsburgh

THE PITTSBURGH SCIENCE TECHNOLOGY SOCIETY PROJECT

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Introduction Module

Interrelationships Science - Technology - Society

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INTRODUCTION MODULE

Interrelationships Science - Technology - Society

COMPETENCIES

A. Processes

1. Observing
2. Classifying
3. Inferring
4. Predicting
5. Measuring
6. Communicating
9. Formulating Hypotheses
10. Experimenting
11. Recognizing Variables
12. Interpreting Data

ACTIVITIES

1. Science - Technology - Society Inventory
2. Gift of STS
3. Picture A Scientist!
4. Graphing
5. Intro Cards

INSTRUCTIONAL OBJECTIVES

At the end of these lessons, each student should be able to:

1. identify and compare at least five changes in our society over the last 100 years, in relation to transportation, homes, food, communication, health, occupations, education, and/or clothing.
2. list at least five reasons "why" having good organizing skills is essential for the student in today's society.
3. identify possible relationships between two variables.
4. create a physical representation of collected data.
5. devise a scale appropriate to the data to show direct relationships.
6. interpret prepared graphs.

Activity 1. Science - Technology - Society Inventory

Objectives: Students will be able to identify and compare changes in our society over the last century in relation to transportation, homes, food, communication, health, recreation/forms of entertainment, occupations, education, and clothing.

Student Activity Sheets: SAS 1.1 Inventory I
SAS 1.2 Inventory II

Teacher Background:

This activity is designed to help students understand the interrelationships between Science - Technology - Society.

The aim is to generate discussion between teacher, student, and family members about changes in our society that have come about due to advances in science and technology.

It is hoped that this activity will begin the process of making science more relevant to the student and his family, and help to develop a rapport between student and teacher.

The design of each module in the set of five modules is the same. White pages in the module contain teacher information (which may/may not be shared with students). The yellow pages are Student Activity Sheets (SAS) to be duplicated for individual student use. All pages are consecutively numbered in the modules.

Example of Introductory Anticipatory Set

Teacher. "What disease are you afraid of? concerned about?
Student. "(AIDS, cancer, etc.)"
Teacher. "Is anyone concerned about polio, diptheria, scarlet fever? etc."
Teacher. "Tonight, or during one of the next several days, ask your parents if they are afraid of these diseases."

Teacher. "100 years ago what diseases do you think people were afraid of in Pittsburgh?

Pass out STS Inventory I to be completed by students after they interview their parents, grandparents, other relatives or using their own ideas and resources.

Resources:

Science 84, November 1984 - This is an excellent reference that illustrates scientific discoveries that have had an impact on our lives.

Other science magazines and journals have had similar issues devoted to technological advances that have impacted our lives.)

Directions: Complete the chart below with your own ideas, by asking your parents or grandparents or referring to reference books.

	1886	1930	1960	1986
Transportation				
Kinds				
Homes				
Heating				
Lighting				
Appliances				
Location				
Construction				
Food				
Produced (where obtained)				
Prepared				
Stored				
Where eaten				
Communication				
Type				
Most often used				
Speed				
Health				
Feared diseases				
Causes of death				
Life span				
Forms of Energy				
Recreation/ Entertainment				
Forms				
Amount of Leisure Time				
Occupations				
Major occupations				
Types of skills				
Education				
Years in school				
Size of grade school				
Size of high school				
Clothing				
Type of material				
Where produced				

Transportation

1. If you wished to travel to Los Angeles, California, how long on an average, would it take in 1886?
   1930?
   1960?
   1986?

2. Put the following in order of their development:

   rocket engine
   jet engine
   steam engine
   gasoline engine

Homes

1. How is today's home different from the log cabin of 1886 in terms of

   heating?
   lighting?
   appliances?
   location?
   construction?

2. Which of the changes listed in question 1 are a result of technology?

Food

How would meal preparation be different today from what it was in 1930 in terms of:

time?
types of food?
method of preparation?

Communication

How quickly would you have been able to contact a relative living in Dallas, Texas in 1886? How long would it take today?

Put the following forms of communication in order of their development:

satellite communications
telegraph
direct communication
postal service
telephone

Health

1. What has contributed to increased life span?
2. How is health care different today than it was 25 years ago?
3. What diseases are you afraid of? Has anyone here ever been quarantined?
4. How have causes of death changed since 1900?

Forms of Energy

1. How has modern technology depleted the supply of fossil fuels?
2. List some forms of energy that are alternatives to fossil fuels?
3. Name some advantages and disadvantages of nuclear energy?

Recreation

1. List some types of recreational activities that were not possible 100 years ago.
2. How is car racing a good example of how technology has changed the nature of this form of recreation.

Occupation

1. What kinds of jobs did not exist 50 years ago?

SAS 1.2
(continued)

2. How has technology replaced the following occupations of the past:

blacksmith
iceman
chimney sweep
cotton picker
grape picker

Education

1. What kinds of courses were emphasized 50 years ago for the typical student attending school?

2. What kinds of courses are offered today because of our advanced technology?

3. Why are people today staying in school for longer periods of time?

Clothing

1. In 1910, a woman might spend hours ironing clothes for her family. Why has this changed today?

2. Classify the following fibers as natural or man-made.

silk
banlon
orlon
rayon
cotton
nylon
wool
linen
acrilon
banlon

General questions:

1. Pick three categories above and describe how technology has made great strides in that particular area.

2. How has improved technology caused the family to change from 1886 to today?

3. What kinds of technology might be prevalent 50 years from now?

Activity 2. Gift of STS

Objectives: Each student should be able to give several reasons why having good organizing skills is essential for a student in today's society.

Suggested Procedure:

1. Discuss with the students any great gifts (presents) they would like to receive or give at Christmas/or birthday.

2. Have the students write down on paper the one best gift and a list of all the components (or things) the gift should have.

Example:

VCR

	store- 1	2	3
heads			
VHS			
remote			
on-screen programming			
still			
no. of events			
no. of weeks			
front loading			
stereo			

3. Have the students investigate different stores which sell the items. Students should find out prices, options, other features, distance travelled to store and cost, etc.

4. During a follow-up session, discuss with students the importance of organizing information so that good decisions might be made.

5. Discuss with the students their knowledge of terminology that has been brought up by the students in listing the gifts (examples, overhead cam, fuel injection, frequency modulation, and China Syndrome).

6. discuss how science and technology have made our lives easier but often more complicated by some of the gifts listed by students.

Activity 3. Picture A Scientist!

Objectives:

Students should be able to:

1. develop an awareness of different peoples concepts of scientists.
2. develop a better understanding and awareness of scientists as individuals.
3. develop an awareness of how personal life experiences effect one's perceptions of scientists (and other things).

Suggested Procedure:

1. Give each student a blank sheet of paper and have them draw his idea of what a scientist looks like.
2. After the students draw their pictures (allow 10-15 minutes), collect/show off the pictures in the classroom. Allow the students to view each others drawings. Have the students individually or in small groups organize the drawings by similarities and differences. Do they find certain similarities? (many males, white, middle-aged, ties, weird hair, pens in pocket, scientific equipment?)
3. Do any of the students suggest a pattern of stereotyping? The teacher might lead a discussion of stereotyping. Where do the students ideas originate from? How might their feelings/attitudes affect future decisions such as career choice and college major. How might their ideas today effect their future ideas concerning science/or becoming a scientist?

Activity 4. Graphing

Objectives:

Students should be able to:

1. identify possible relationships between two variables.
2. create a physical representation of collected data.
3. devise a scale appropriate to the data in order to show direct relationships.
4. interpret prepared graphs.

Teacher Background:

This activity is designed to familiarize the students with the process of graph making.

The following terms should be reviewed to enhance an understanding of the activity.

- Axis
- Interpolation
- Data
- Best Fit Line
- Bar Graph
- Coordinate
- Extrapolation
- Data Table
- Line Graph
- Scale

Materials:

- Graph Paper
- Pencils
- Rulers
- Erasers

Student Activity Sheets:

SAS 4.1 Graphing

Graphing

A. Grouping Data

1. Five pieces of metal are weighed and are listed in the order that they were measured: 20.0 g., 40.3 g., 30.7 g., 37.1 g., and 28.6 g.

2. Round off the weights to the nearest whole number and include them in the following table in order from lowest (no. 1) to highest (no. 5).

NUMBER	WEIGHT
1	
2	
3	
4	
5	

B. Constructing A Bar Graph

1. Using a 8 1/2 by 11 inch graph paper with the wholes across the front of you, count in 6 lines from the left margin and 6 lines from the bottom of the paper to locate the origin.

2. Draw the X (horizontal) axis and the Y (vertical) axis from this origin.

3. An easy way to scale your graph is to count the number of available spaces on each axis. If you try this with the X axis, you should get ____ spaces. Find the largest value that you will be graphing. Divide the largest value by the smaller. If the spaces were larger, drop the decimal and this is the value of each space. If the values were larger, then, round the answer off to a whole number and this is the value of each space. You have now constructed a scale that will correctly represent your data and use most of the available space.

4. Label the X axis by counting over 5 lines and labeling it 5 grams. Continue counting and labeling in this manner until the X axis is complete.

Graphing

B. Constructing a Bar Graph (Continued)

5. Following a similar procedure, let's devise a scale for the Y axis. One unusual thing is that there are 39 spaces available and only 5 items to plot on the Y axis. How many spaces would you eliminate so that the number of items divides evenly into the number of spaces? _____ 35 spaces would be a good answer since 35 / 5 = 7. Therefore, count up 7 lines from the origin and label it number 1. Continue counting and labeling in this manner until the Y axis is complete.

6. Plot the data, making the bars as wide as you wish (but making all bars equal in thickness).

C. Graphing Checklist

A properly constructed graph should include the following items which have been placed in checklist form so that they can be checked as you include each part.

1. ___ a descriptive title

2. ___ a zero point (origin)

3. ___ an x and y axis

4. __ __ each axis properly labeled.
   x y

5. __ __ uniformly spaced number
   x y on each axis (scaling)

6. _____ accurately plotted points from the data.

7. _____ completed lines or bars.

A GENERAL EXPLANATION OF ONE VARIABLE SCALED GRAPHING AND TWO VARIABLE SCALED GRAPHING

After reading through the program ONE VARIABLE and TWO VARIABLE, I came to the realization that, while the programs are rather straight-forward in their soultion of the problem, the novice user may have some difficulty in understanding their logic. What follows is a discussion of the steps involved in the programs.

1. The first section of the program asks the user to enter the number of trials and will not let him continue until a number between 10 and 30, inclusive, is entered. The number of trials is assigned the variable name TR.

2. The computer is told to make room for TR number of trials via the DIMension statement (this is called creating a table). Then a loop (called in BASIC a FOR...NEXT loop) is set up to allow input of the results of the TR trials. In ONE VARIABLE only one numeric entry is required for each pass through the loop and those entries are stored in the D(n) table, where n is the number of the pass. In TWO VARIABLE two numeric entries are required and they are stored in two tables X(n) and Y(n).

3. Now that the data has been entered into the computer, we must find the minimum and maximum values for the variables. We do this by setting the minimum and maximum equal to the first variable in our table. Then a loop is established to test each variable to see if it is less than the minimum. If it is less than the minimum, the minimum is lowered to the value of the variable. In a like manner the maximum is tested.

4. To draw the graph we must first turn on the graphics screen (HGR) and choose a color (HCOLOR = 3). Then we draw a box around the screen. It should be noted that the APPLE graphics screen does not confirm to Cartesian rules, i.e., the origin is in the UPPER left hand corner, not the lower left hand corner.

5. A loop is created to plot the points on the screen, but first each point must be scaled to fit on the screen. Since we drew a border around the screen we reduced our screen size from 280 x 160 to 278 x 158 with the upper left corner being 1,1 and the lower right corner being 278,158. The scaling formula is just a version of the two point form for finding the equation of a line.

$$Y - Y1 = \frac{Y2 - Y1}{X2 - X1} (X - X1)$$

where the values of X1 and X2 are the minimum and maximum values and Y1 and Y2 are the extreme values for the screen.

```
PR#0
]LIST

10  REM  THIS PROGRAM ASKS FOR THE RESULTS OF BETWEEN 10 AND 30 TRIALS, T
     HEN SCALES THE DATA FOR THE APPLE II GRAPHICS SCREEN
20  REM  NOTE THAT THE APPLE GRAPHICS SCREEN IS 280 POINTS HORIZONTALLY (
     0 THRU 279) AND 160 POINTS VERTICALLY (0 THRU 159) WITH (0,0) BEING
     THE UPPER LEFT HAND CORNER
30  REM  *** INPUT THE NUMBER OF TRIALS
40  HOME : REM  CLEAR THE SCREEN
50  INPUT "NUMBER OF TRIALS (10-30) ";TR: REM  ENTER THE NUMBER OF TRIALS
      TO BE USED
60  IF TR < 10 OR TR > 30 THEN  PRINT "RANGE IS 10 THRU 30 ONLY!!!"; CHR$
     (7): GOTO 50: REM  CHECK THE RANGE OF TRIALS.  IF INCORRECT THEN BEE
     P AND REDO
70  REM  *** INPUT TRIAL DATA
80  DIM D(TR): REM  MAKE ROOM IN THE COMPUTER FOR THE RESULTS OF TR TRIAL
     S
90  FOR I = 1 TO TR: REM  ESTABLISH A LOOP TO ENTER THE DATA
100  PRINT "TRIAL #";I;: REM  PRINT PROMPT
110  INPUT D(I): REM  INPUT THE RESULTS OF THE ITH TRIAL
120  NEXT I: REM  CLOSE THE LOOP THAT WAS FORMED IN LINE 90
130  REM  *** SCAN FOR MINIMUM AND MAXIMUM VALUES
140 MN = D(1):MX = D(1): REM  INITIALIZED THE MINIMUM AND MAXIMUM VALUES
      TO THE FIRST DATA VALUE
150  FOR I = 1 TO TR: REM  SET UP A LOOP
160  IF D(I) < MN THEN MN = D(I): REM  IF THE DATA VALUE IS LESS THAN THE
      MINIMUM, THEN MAKE THE MINIMUM EQUAL THE DATA VALUE
170  IF D(I) > MX THEN MX = D(I): REM  IF THE DATA VALUE IS GREATER THAN
     THE MAXIMUM, THEN MAKE THE MAXIMUM EQUAL THE DATA VALUE
180  NEXT I: REM  CLOSE THE LOOP
190  REM  *** DRAW THE GRAPH
200  HOME : HGR : HCOLOR= 3: REM  CLEAR THE SCREEN, TURN ON THE GRAPHICS
     SCREEN, AND SET THE COLOR TO WHITE
210  HPLOT 0,0 TO 279,0 TO 279,159 TO 0,159 TO 0,0: REM  DRAW A BOX AROUN
     D THE SCREEN
220  VTAB 21: HTAB 1: PRINT "MINIMUM = ";MN: REM  PRINT THE MINIMUM ON TH
     E BOTTOM OF THE SCREEN
230  VTAB 22: HTAB 1: PRINT "MAXIMUM = ";MX: REM  PRINT THE MAXIMUM ON TH
     E BOTTOM OF THE SCREEN
240  FOR I = 1 TO TR: REM  SET UP ANOTHER LOOP
250 Y = 157 * (D(I) - MX) / (MN - MX) + 1: REM  SCALING FORMULA FOR THE Y
      POSITION ON THE SCREEN
260 X = 270 * I / TR: REM  SCALING FORMULA FOR THE X POSITION ON THE SCRE
     EN
270  HPLOT X,Y: REM  PLOT THE POINT
280  NEXT I: REM  CLOSE THE LOOP
290  VTAB 23: HTAB 1: PRINT "PRINTOUT OF THE POINTS (Y/N)  ";: GET X$: IF
     X$ = "N" OR X$ = "n" THEN 400
300  IF X$ = "Y" OR X$ = "y" THEN 320
310  PRINT  CHR$ (7);: GOTO 290
320  PR# 1
330  PRINT : PRINT
340  PRINT "NUMBER     VALUE"
350  PRINT
360  FOR I = 1 TO TR
370  PRINT  SPC( 3 - (I > 9));I; SPC( 7);D(I)
380  NEXT I
390  PR# 0
400  END
```

```
    ACH WITH TWO VARAIBLES, AND THEN SCALES THE DATA FOR THE APPLE GRAPH
    ICS SCREEN
20  REM  NOTE THAT THE APPLE GRAPHICS SCREEN IS 280 POINTS HORIZONTALLY (
    0 THRU 279) AND 160 POINTS VERTICALLY (0 THRU 159) WITH (0,0) BEING
    THE UPPER LEFT HAND CORNER
30  REM  *** INPUT THE NUMBER OF TRIALS
40  HOME : REM  CLEAR THE SCREEN
50  INPUT "NUMBER OF TRIALS (10-30) ";TR: REM  ENTER THE NUMBER OF TRIALS
     TO BE USED
60  IF TR < 10 OR TR > 30 THEN  PRINT "RANGE IS 10 THRU 30 ONLY!!!"; CHR$
    (7): GOTO 50: REM  CHECK THE RANGE OF TRIALS.  IF INCORRECT THEN BEE
    P AND REDO
70  REM  *** INPUT TRIAL DATA
80  DIM X(TR),Y(TR): REM  MAKE ROOM IN THE COMPUTER FOR THE X,Y RESULTS O
    F TR TRIALS
90  PRINT : REM  PRINT A BLANK LINE PRIOR TO INPUT
100  FOR I = 1 TO TR: REM  ESTABLISH A LOOP TO ENTER THE DATA
110  PRINT "TRIAL #";I;" X VALUE ";: REM  PRINT X PROMPT
120  INPUT X(I): REM  INPUT THE ITH X VALUE
130  PRINT "TRIAL #";I;" Y VALUE ";: REM  PRINT Y PROMPT
140  INPUT Y(I): REM  INPUT THE ITH Y VALUE
150  PRINT : REM  PRINT A BLANK LINE BETWEEN TRIALS
160  NEXT I: REM  CLOSE THE LOOP THAT WAS FORMED IN LINE 90
170  REM  *** SCAN FOR MINIMUM AND MAXIMUM VALUES
180 X1 = X(1):X2 = X(1):Y1 = Y(1):Y2 = Y(1): REM  INITIALIZE THE MINIMUM
     AND MAXIMUM VALUES FOR X AND Y, X1 = MIN X, X2 = MAX X, Y1 = MIN Y,
     AND  Y2 = MAX Y
190  FOR I = 1 TO TR: REM  SET UP A LOOP
200  IF X(I) < X1 THEN X1 = X(I): REM  IF THE X VALUE IS LESS THAN THE X
     MINIMUM, THEN MAKE THE X MINIMUM EQUAL THE X VALUE
210  IF Y(I) < Y1 THEN Y1 = Y(I): REM  IF THE Y VALUE IS LESS THAN THE Y
     MINIMUM, THEN MAKE THE Y MINIMUM EQUAL THE Y VALUE
220  IF X(I) > X2 THEN X2 = X(I): REM   IF THE X VALUE IS GREATER THAN TH
     E X MAXIMUM, THEN MAKE THE X MAXIMUM EQUAL THE X VALUE
230  IF Y(I) > Y2 THEN Y2 = Y(I): REM   IF THE Y VALUE IS GREATER THAN TH
     E Y MAXIMUM, THEN MAKE THE Y MAXIMUM EQUAL THE Y VALUE
240  NEXT I: REM  CLOSE THE LOOP
250  REM  *** DRAW THE GRAPH
260  HOME : HGR : HCOLOR= 3: REM  CLEAR THE SCREEN, TURN ON THE GRAPHICS
     SCREEN, AND SET THE COLOR TO WHITE
270  HPLOT 0,0 TO 279,0 TO 279,159 TO 0,159 TO 0,0: REM  DRAW A BOX AROUN
     D THE SCREEN
280  VTAB 21: HTAB 1: PRINT "X MIN = ";X1; TAB( 20);"X MAX = ";X2: REM  P
     RINT THE X MINIMUM AND MAXIMUM ON THE BOTTOM OF THE SCREEN
290  VTAB 22: HTAB 1: PRINT "Y MIN = ";Y1; TAB( 20);"Y MAX = ";Y2: REM  P
     RINT THE Y MINIMUM AND MAXIMUM ON THE BOTTOM OF THE SCREEN
300  FOR I = 1 TO TR: REM  SET UP ANOTHER LOOP
310 X = 277 * (X(I) - X1) / (X2 - X1) + 1: REM  SCALING FORMULA FOR X
320 Y = 157 * (Y(I) - Y2) / (Y1 - Y2) + 1: REM  SCALING FORMULA FOR Y
330  HPLOT X,Y: REM  PLOT THE POINT
340  NEXT I: REM  CLOSE THE LOOP
350  VTAB 23: HTAB 1: PRINT "PRINTOUT OF THE POINTS (Y/N)  ";: GET X$: IF
     X$ = "N" OR X$ = "n" THEN 460
360  IF X$ = "Y" OR X$ = "y" THEN 380
370  PRINT  CHR$ (7);: GOTO 350
380  PR# 1
390  PRINT : PRINT
400  PRINT "NUMBER      X-VALUE     Y-VALUE"
410  PRINT
420  FOR I = 1 TO TR
430  PRINT  SPC( 3 - (I > 9));I; SPC( 7);X(I); TAB( 24);Y(I)
440  NEXT I
```

Activity 5 Intro Cards

Objectives:

Students will be able to:

1. organize ramdom data.
2. define operationally the concepts interpolation and extrapolation.
3. explain the importance of organizing data as a scientific process.

Teacher Background:

Making the Intro Cards: You can choose any number of combinations of numbers (from the master card p.16 Intro Card). Using a master sheet, ditto off (copy) enough sets of cards for each group of students. You might choose to glue the sheets to cardboard for demonstration purposes (back of pad Fs work fine). Make sure you glue the whole sheet.

Then cut the squares and arrange them in columns (1-7) and rows. Color each column of numbers (1, 8, 15, 22, 29, 36) with a different color.

The extras are colored at random. Place the extras on their corresponding double and remove extra pieces.

Remove 2 or 3 numbers from the pile, shuffle the cards and put a rubber band around them.

Although alot of initial work, the cards last many years.

Materials:

one set of cards per set of students, master sheet for making cards.

Suggested Procedure:

1. Give each student or group a pack of cards and have them spread the cards out on the surface with the numbers facing up.
2. Have the students try to put the cards in some organized fashion (allow time for some work and some frustration).
3. When the students begin to organize them, begin to ask about duplicates and/or missing numbers.
4. Discuss with individual groups how they knew what colored number to keep or throw away.
5. Ask the color of several numbers that are beyond the range of cards.

Discussion

Bring into your discussions the meaning of interpolation and extrapolation; the importance of organizing data in order to interpret information; the purpose of the data table; scientific methods; and everyday problem-solving.

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Into Card (Master)

1	2	3	4	5	6	7	8
9	10	11	12	13	14	15	16
17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32
33	34	35	36	37	38	39	40

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PITTSBURGH STS PROJECT

TEACHER EVALUATION FORM

Name ______________________________ Module: Intro A 1 2 3 4
(circle one)

School ______________________________

Activity Title & Number ____

Grade Level ______________________________ ______________________________

Please ANSWER EACH OF THE FOLLOWING QUESTIONS AT THE COMPLETION OF EACH ACTIVITY. Please comment in more detail on separate pages of paper where appropriate. Circle the most appropriate response.

1. OBJECTIVES

Were the stated objectives clear and accurate? Excellent Good Poor

2. TEACHER BACKGROUND

Was the teacher background accurate? Excellent Good Poor

Was the information provided a sufficient background on the subject? Excellent Good Poor

3. MATERIALS

Was the materials list complete? Excellent Good Poor

Did you have enough of each material required? Excellent Good Poor

*Please indicate any resources, books (teacher or student), equipment, etc. that your recommend for inclusion in future modules.

4. STUDENT ACTIVITY SHEETS

Were the Student Activity Sheets (SAS):

Relevant to the objectives? Excellent Good Poor

Clear and logical? Excellent Good Poor

*Which were the most successful activities?

5. EXTENDED ACTIVITIES

*Have newly acquired decision making skills lead to action on personal problems? Involvement in community organizations? Involvement in local government issues? Other?

6. EVALUATION

What method of student evaluation did you use? (SAS sheet, separate test, etc.?)

*How successful were the students?

7. PROCEDURE

Was the suggested procedure clear and complete? Excellent Good Poor

*Did you follow the suggested procedure? What modifications, if any, did you make?

8. RATE THE FOLLOWING: (circle one)

Student interest	High	Medium	Low
Appropriateness of material for students	High	Medium	Low

9. Do you recommend this activity for future use?

10. Other comments/recommendations:

Teacher signature ______________________________ Date __________

Date when Activity was completed ________________________

The PIT STS Project

MODULE I

THE PITTSBURGH SCIENCE TECHNOLOGY SOCIETY PROJECT

THE AUTO AND ENERGY

THE PITTSBURGH SCIENCE TECHNOLOGY SOCIETY PROJECT

MODULE I

THE AUTO AND ENERGY

developed by

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with the Inservice Workshop Participants

June, 1988

George O'Brien, Project Director and Series Editor
University of Pittsburgh

THE PITTSBURGH SCIENCE TECHNOLOGY SOCIETY PROJECT

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Module I

The Auto and Energy

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MODULE I

The Auto and Energy

COMPETENCIES

A. Processes

1. Observing
2. Classifying
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5. Measuring
6. Communicating
8. Defining Operationally
10. Experimenting
12. Interpreting Data
13. Formulating Models

ACTIVITIES

1. Naming the Energy Form
2. Energy Conversion Box
3. Heat Energy Converted to Mechanical Energy

3A. Heat converted to Mechanical Energy (Modified Procedure)

4. Energy Conversions
    a. Traditional Measurement
    b. Microcomputer Lab Interfacing Procedure

INSTRUCTIONAL OBJECTIVES

At the end of these lessons, each student should be able to:

1. Demonstrate how stored chemical enery can be converted to heat energy.

2. Describe how heat energy can be converted into mechanical energy.

3. Demonstrate how a steam turbine changes heat energy into mechanical energy.

4. Determine quantitatively an amount of heat energy and relate it to a corresponding amount of mechanical energy.

5. Relate graphically the change in the volume of water used in the turbine apparatus to the amount of mechanical energy it produces.

6. Construct simple electrical circuits.

INSTRUCTIONAL OBJECTIVES (continued)

7. Infer through experimentation that chemical energy is converted to electrical energy in a dry cell.
8. Demonstrate experimentally how electrical energy can be coverted to heat and light energy.
9. Construct a data table and graph the results.
10. Describe one form of energy being converted into another form.
11. Label an example of a conversion of one energy form to another.

*12. Construct a thermistor (microcomputer interface techniques).

*13. Calibrate a thermistor.

*14. Collect and interpret data using a microcomputer/thermistor lab interfacing technique.

*Optional objectives

ACTIVITY 1. Naming the Energy Form

Objectives: The student should be able to:

1. demonstrate how stored chemical energy can be converted to heat energy.
2. describe how heat energy can be converted into mechanical energy.

Teacher Background: Ask students when they last used energy. Do they have any idea how energy is used? Is energy heat, light, electricity, magnetism? What is energy anyway? (It is the ability to produce heat, light, or to do work). What has to happen before energy can be used to do work? (It often has to be changed into another form). What is energy? The first step in trying to define energy is to set up two categories. Energy in the form of motion, heat, or light is called KINETIC ENERGY. Energy that is stored in food, gasoline, and the nucleus of atoms and batteries is called POTENTIAL ENERGY. Kinetic is energy on the move. Potential energy is stored energy and it is in this form that we dig it from mines and pump it from wells. To use energy it must be in kinetic form.

We use energy because we want to do something to matter; move it, illuminate it, or warm it. We usually store energy in the potential form. A simple way to store energy is to lift something away from the earth (energy is stored when water is pumped to the top of a water tower, then converted to kinetic energy when it is allowed to run through pipes).

It is possible to convert a certain amount of mechnical energy to heat by, for instance, putting on the brakes of a car. It is possible to convert the chemical energy of coal into heat by burning it. These conversions cannot go to completion in the other direction, only a limited amount of heat energy is covertible back to other forms. There are many forms of energy but before most energy can be used for work it first must be changed into mechanical energy.

Below are some brief descriptions of basic forms of energy.

Chemical Energy is released when matter changes chemically. When wood burns, it combines chemically with oxygen and gives off heat.

Mechanical Energy is produced by motion.

Electrical Energy is a flow of electrons. It can be changed into many other forms such as heat, light and sound.

Atomic Energy is released when atoms split or combine.

Heat Energy is released as the kinetic energy of the atomic particles increases.

Light Energy is a form of energy which travels by transverse waves (vibrate in all directions).

Sound Energy is produced when matter vibrates.

Student Activity Sheets: SAS 1.1 Naming the Energy Form

THE ENERGY STORY

A. You have all had science classes before this one. In all of those classes you studied energy. Please write as many forms that energy can appear on the lines below.

1. ______________ 5. ______________

2. ______________ 6. ______________

3. ______________ 7. ______________

4. ______________ 8. ______________

B. Energy can be stored or used. If we have it stored away, it is called ______________ energy. If we are using energy, it is called ______________ energy. For each of the above energies, give an example where the stored (potential) energy is changed into moving (kinetic) energy.

1. ______________

2. ______________

3. ______________

4. ______________

5. ______________

C. In the following weeks, we will be studying the automobile. Give examples, using the automobile, of changes from potential energy to kinetic energy from the listed energies above.

1. ______________

2. ______________

3. ______________

4. ____

5. ____

D. In a car, chemical energy is changed to __________________ and ______________________ energy when the gasoline burns. The mechanical energy is changed into ___________________ energy to light the _________________, move the guages, fire the _________ _____________, and recharge the battery. Mechanical energy is also transferred from the up and down motion of the pistons to the turning of the _________. When you push on the brake pedal, mechanical energy is transferred into _______ energy in the brakes. Many changes are taking place in a car when you run it.

Name three forms of energy that are stored when the car is parked in the garage and not running and tell where they are in the car.

	energy	**where stored**
1.	___________________________	____________________________________
2.	___________________________	____________________________________
3.	___________________________	____________________________________

The person who first made a working automobile must have been both smart and good with their hands. They had to have a picture in their mind of what the engine would look like, how it would fit together and what it would do. This is called a MENTAL MODEL. A _______ is a picture, object or idea that helps us see the real thing even if it is too big or too small to hold easily.

Close your eyes and think of a car. What color is it? What make and model is it? How fast can it go? This is a _____________ model.

I.

The car is not really in your head. A map is a model of a section of the earth. List five models below and tell what each represents.

1. ______________________ ______________________
2. ______________________ ______________________
3. ______________________ ______________________
4. ______________________ ______________________
5. ______________________ ______________________

In the car makers mind he (or she) needed to know how big to make the engine and what parts to add to make the car go. List below as many engine parts or parts of a car that make it go.

______________ ______________ ______________
______________ ______________ ______________
______________ ______________ ______________
______________ ______________ ______________

The car maker had to know what the fuel (usually gasoline) does inside the engine. He (or she) had to calculate the amount of energy that the gas would release. Boy!! Was he smart.

Besides the size of the engine, what other factors (problems) do you think the car maker would have to consider in making a car?

1. ____
2. ____
3. ____
4. ____
5. ____

I.

List below some things that you would look for if you were buying a car.

1. ______________________________ 2. ______________________________

3. ______________________________ 4. ______________________________

5. ______________________________ 6. ______________________________

In the next experiment, we will see some of the data that might have been collected in order to figure out how big to make the engine.

ACTIVITY 2. Energy Conversion Box (Evaluation Sheet)

Objectives: The student should be able to:

1. describe one form of energy being converted into another form.
2. label an example of a conversion of one energy form to another.

Lesson Evaluation Activity: Distribute copies of the evaluation matrix (energy conversion box) to the class. Have students fill the blank spaces with examples of energy conversions. Use the responses as a form of evaluation. Challenge the students to fill in the blank blocks within a time limit, counting each correct answer 5 points. Winner would accumulate the highest number of points.

Teacher Background; Energy can be changed from one form to another. Various kinds of energy are often made available by chemical changes. Many times heat and light are given off when other substances combine with oxygen during burning. Physical changes can also produce energy. For example, heat is absorbed when a gas expands inside a pipe. In fact, this is the principle used in refrigeration. Man finds many ways to unleash energy. Electricity that travels for miles along wires can be changed into radio waves which transmit man's ideas. We can make a chemical reaction in an automobile battery provide the electricity for the car. Man can release the energy in fuels by burning and sending airplanes into flight. Coal can be used to turn water into steam and in turn use this steam to run trains and to generate electricity. He can use light energy to regulate the amount of electricity through the photoelectrical cell. Some energy comes from light, other energy from heat. Even sound is a form of energy. Mechanical energy is being used when man uses a stream or river to turn a water-wheel. All these examples demonstrate that energy can be transformed from one form to another.

Great amounts of energy can be produced from the nucleus of an atom. The nuclei of certain atoms can produce much more energy than can be made by chemical means.

Evaluation Sheet

Directions: Write in each box examples of one form of energy being converted into another form. Begin with the vertical column on the left. Example: Heat is converted into light energy in a light bulb, so write "light bulb" in the box formed by the intersection of the two energy forms.

	HEAT	LIGHT	SOUND	MECHANICAL (Movement)	CHEMICAL	ELECTRIC	NUCLEAR
HEAT		light bulb fire electric arc	explosions	steam turbine	disassociation of water or other molecules	thermionic effects	nuclear reactions in stars
LIGHT	infra red absorption			light pressure photoelectric effect	photosynthesis other photochemical reactions	solar cell, other photovoltaic effects	
SOUND	sound eventually dissipates as heat	sound converted to modification of laser beam		sound is a mechanical motion of molecules		microphones, telephones	
MECHANICAL (Movement)	rubbing hands, friction in general	non-electrical sparks	vocal cords, musical instruments			electric generator	cyclotrons & other high energy machines
CHEMICAL	gas furnaces, fuels in general	fuel burning, fire-fly phosphorescence	firecrackers, other explosives			fuel cell battery	
ELECTRIC	incandescent light, iron, cooking	fluorescent light, television	telephone speakers, radio, etc.	motor	charging storage battery		
NUCLEAR	nuclear reactor, fusion reaction	nuclear bomb	nuclear bomb	nuclear bomb		"nuclear batteries"	

1.

Evaluation Sheet

Directions: Write in each box examples of one form of energy being converted into another form. Begin with the vertical column on the left. Example: Heat is converted into light energy in a light bulb, so write "light bulb" in the box formed by the intersection of the two energy forms.

	HEAT	LIGHT	SOUND	MECHANICAL (Movement)	CHEMICAL	ELECTRIC	NUCLEAR
HEAT		LIGHT BULB					
LIGHT							
SOUND							
MECHANICAL (Movement)							
CHEMICAL							
ELECTRIC							
NUCLEAR							

ACTIVITY 3 Heat Energy Converted to Mechanical Energy

Objectives: The students should be able to:

1) demonstrate how a steam turbine changes heat energy into mechanical energy.

2) determine quantitatively an amount of heat energy and to relate it to a corresponding amount of mechanical energy.

3) relate graphically the change in the volume of water used in the turbine apparatus to the amount of mechanical energy it produces.

Teacher Background: Moving people and materials from one-place to another has always been a problem. Many different kinds of transportation have been used. Before this century, most transportation was accomplished by walking, by animal power, or by boat. Now most people walk less than ever before. Today machines move us and our merchandise faster and easier than did the older methods.

However, to support these transportation systems requires a large expenditure of energy. Most of this energy comes from the burning of fossil fuels. The rate at which these fuels are being used today is staggering. This presents somewhat of a problem since fossil fuels are considered to be limited. That is to say that there is only a certain amount in nature and when that is exhausted it will take millions of years for new ones to be formed.

The automobile accounts for about 20 percent of all the energy used in the United States. Thus using the automobile as our primary means of transportation compounds the problem of energy consumption for several reasons. First of all, the automobile is quite limited in the number of passengers or the amount of cargo it can transport. Secondly, the internal combustion engine used in most automobiles is not very efficient. In scientific terms efficiency can be expressed as $\frac{\text{WORK OUT}}{\text{WORK IN}} \times 100\%$ For the average automobile, this figure is about 27%.

The low efficiency factor for the internal combustion engine is due to a number of reasons. In general, every time energy is converted from one form to another, energy is usually given up to the environment in some non-useable form. In the automobile, many of these energy conversions take place. For example, the potential energy (chemical) of the gasoline is changed to heat energy from combustion within the cylinders which in turn is converted to mechanical energy. Now the mechanical energy is used to do many different things, some of which involve even further energy changes. For example, some of this mechanical energy is transferred through the drive train to move the car. It is also used to turn the generator to produce electricity. Some is even used to cool the engine (wasted heat) by turning the fan and water pump. At each of these steps along the way, some energy is given up to the environment as heat and cannot be captured and used again.

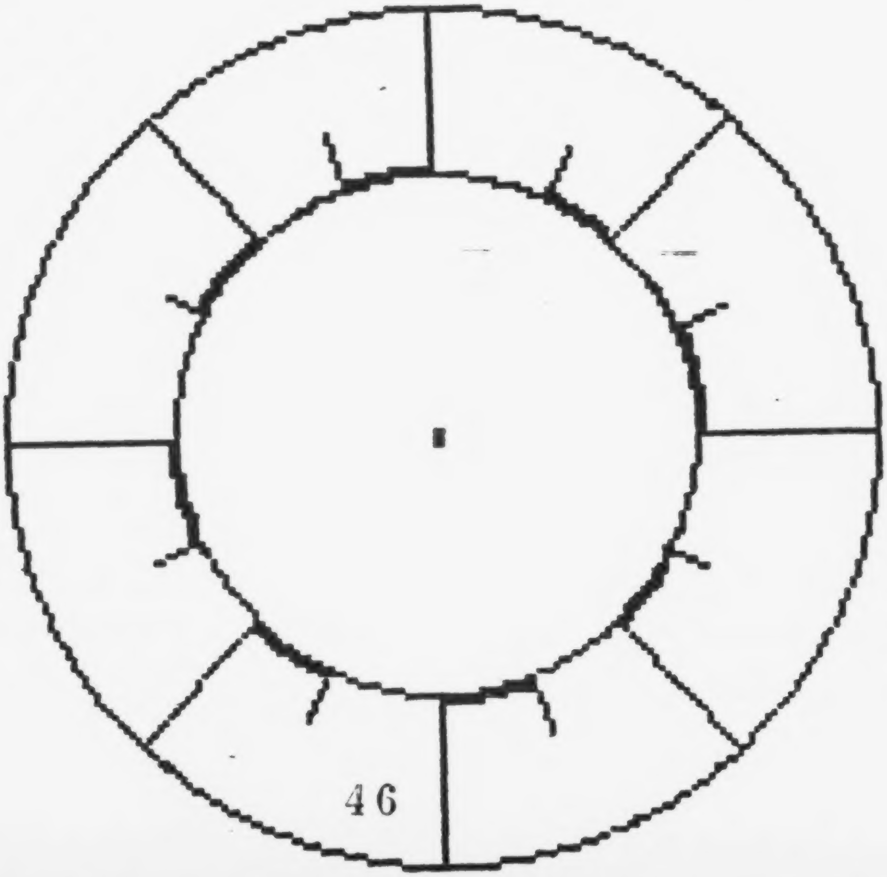
In this activity the student will observe a similar conversion of energy as it could occur in an electric power plant. Whether nuclear or coal-fired, such a plant is designed to employ a heat source to convert water to steam in order to drive the blades of a turbine and in turn, to produce (induce) an electric current (perhaps the topic of a future discussion or demonstration). By making a few simple measurements and by using two basic formulas of calorimetry, the student in this activity is able to calculate a total of heat energy in calories transferred from the burning fuel in the alcohol lamp to the water in the test tube. This total heat energy can then be related to an important variable in the conversion to mechanical energy, the revolutions per minute (RPM's) of the pinwheel. The amount of mechanical energy generated is, of course, directly proportional to the RPM's.

One important assumption has been made in the data for the lab. Since its design and operation does not permit a determination of the temperature of the boiling water in the test tube, this temperature has been assumed to be 97°C as a general approximation for most days in Pittsburgh. If you can determine a better value for the day of this activity, feel free to substitute it into the students' data.

The student completes the interpretation of the activity by preparing a bar graph showing the RPM's of the pinwheel as a function of the volume of water in the test tube (really a pressure/volume relationship for the steam generated in the tube). In any case, it should show a general decrease in RPM's as the volume of water in the tube decreases. The data used for the graph is compiled from the individual result of each team of students performing one trial of the experiment over the course of the period.

Instructions are provided for preparing the aluminum pinwheels to be used in the activity. To save time, several students may agree to help to cut out and to prepare these pinwheels in advance of the lab. Needed to make the pinwheels would be the 5"-square piece of aluminum, a pair of scissors, a ruler, and the pinwheel template.

Cut out the template and place it on top of the piece of aluminum (or pie pan). Cut along the edge of the circle and produce the large circle. Keeping the template on the aluminum circle, cut the 8 lines into the smaller circle. Then cut along the inner circle at the darkened line (approximately 1/2 inch). Put a small hole through the center spot. Now place a ruler at the end of the 1/2 inch cuts, across the center of the aluminum (where the small hole is), and line the ruler up with the 1/2 inch cut on the other side. The ruler should extend over both edges of the circle. Draw a line along the ruler. This will give you a guide for bending the fins on the wheel. Do this with the other fins.



A diagram of the assembled apparatus is shown in SAS3.1. The suggested distances in centimeters shown on the diagram were determined using the typical alcohol lamp found in most labs and were included to facilitate the set-up of the apparatus and to maximize its performance. However, if you should be using bunsen burners or a different style of lamp, you may need to modify these distances. Try to keep the same basic positions for each part of the apparatus when making any such changes.

Materials

Ring stand
Test tube clamps
200 x 5 mm test tube
Alcohol lamp
#4 one-hole stopper
Glass tip from medicine dropper
50.0 ml graduated cylinder
Thermometer (°C)
1/32" aluminum sheet (5" sq.)
Unsharpened pencil
Styrofoam cup
Ruler
Marking pen
Graph paper
Thumb tack
Stop watch/wrist watch with sweep hand (one per team)

Student Activity Sheets

a) SAS3.1 Procedure for Converting Heat Energy to Mechanical Energy.

b) SAS 3.2 Student Data and Calculation Sheet.

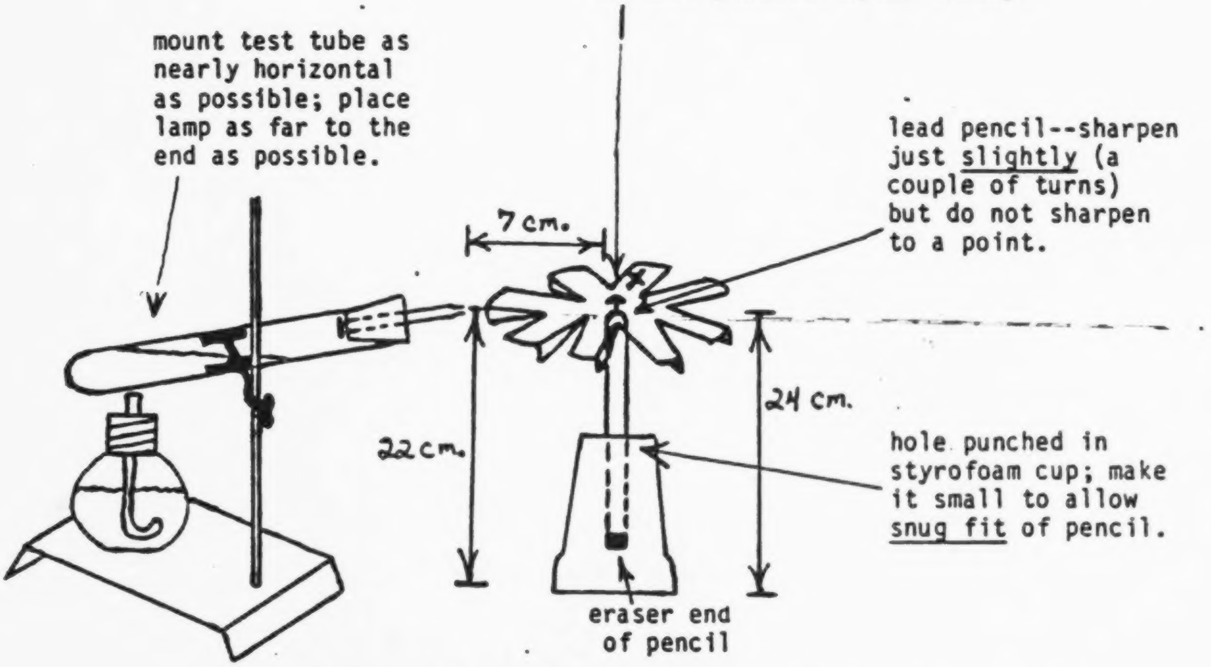
Procedure for Converting Heat Energy to Mechanical Energy

1. Your teacher will indicate the volume of water that you are to use in your experiment (30, 40, or 50 ml.). Write your volume in the blank called "Initial Volume of Water" (V_I) on your data sheet.

2. Using your graduated cylinder, measure out this volume of water and put it in your test tube.

3. Measure the temperature of this water in your test tube with your Celsius thermometer. Place this temperature measurement in the blank called "Initial Temperature of the Water" (T_I) on your data sheet.

4. Set up the apparatus shown in the diagram below:



thumb tack inserted through pinwheel into pencil; do not insert all the way be sure pinwheel spins freely.'

mount test tube as nearly horizontal as possible; place lamp as far to the end as possible.

lead pencil--sharpen just slightly (a couple of turns) but do not sharpen to a point.

hole punched in styrofoam cup; make it small to allow snug fit of pencil.

eraser end of pencil

/Notice that the blades of the pinwheel should almost touch and be level with the end of the tip of the medicine dropper, allowing only enough clearance for the pinwheel to spin freely. (This is usually a distance of 7 cm. between the thumb tack and end of the dropper.)/

5. using a marking pen, make an "X" on any one blade of your pinwheel.

6. Light you lamp and begin to heat the water in your test tube. After a few minutes, the steam produced in the test tube will make the pinwheel begin to move.

7. Once the pinwheel is moving at a steady rate, begin to time your pinwheel and count the "revolutions" (complete turns) that the pinwheel makes, using the "X" on the blade as a reference as it passes in front of you.

8. Count the revolutions as described and get a total for each minute of timing over a three-minute period. Enter your results for "revolutions per minute" (RPM's) in the blank for each of the minutes on your data sheet.

9. Blow-out your flame. While your water and tube are cooling, figure out an average value for your three results for "RPM's" on your data sheet. You will give your teacher this result when requested along with the rest of the lab teams as part of your class data.

10. When your tube is cool, pour the water as completely as possible into your graduated cylinder. Measure the volume, and put your measurement in the blank on the data table called "Final Volume of Water after Heating" (V_F) on your data sheet.

11. Subtract the two volumes in Section 1 on your data sheet to get the differences, V_S, which is the "Volume of Water Changed to Steam" in your activity.

12. Subtract the two temperatures in Section 2 on your data sheet to get the differences called Δ T, the "Change in Temperature of the Water" in your activity.

13. Take your apparatus apart, and check to be sure that you have put all of your measurements on your data sheet. Your teacher will instruct you about the rest of the questions, the problems, and the graph you will do to complete the activity.

I.

SAS 3.2

STUDENT DATA AND CALCULATION SHEET

Name:________________________________

A. **Individual Data:**

1. Your initial volume of water in your test tube (V_I) = ________ ml.

   Your final volume of water after heating (V_F) = ________ ml.

   Volume of water converted to steam (V_S) = V_I - V_F=__________ ml.

2. Temperature of boiling water during heating (T_F) = ________ ml.

   Temperature of water in test tube at the beginning (T_I)= ___ °C

   Change in temperature (ΔT) = ______________ °C

3. Revolutions of the Pinwheel

Minutes	Number of Revolutions
1st	
2nd	
3rd	

b) Add your results for three minutes and divided by "3" to find your average.

Average = ______________ (total) ÷ 3 = ___________rpm (revolutions per min.)

4. What kind of energy is in the alcohol lamp? ___________________

   What kind(s) of energy is the energy in the alcohol lamp being converted to?

   ____

   What change in the water occurs as a result of this conversion of energy?

   ____

***** #5 - #8 are optional or for teacher explanation.

5. Some of the energy change in water causes the water to get hot. It can be found by . . . .

   $\text{Heat}_1 = (1.0\ \text{cal./ml}^{\circ}\text{C}) \times (\Delta T)\ ^{\circ}\text{C} \times (V_I)\ \text{ml.}$

   ΔT = Change the temperature.

   (V_I) ml = The volume you started with.

   a) Put your results in the blanks and multiply:

   $\text{Heat}_1 = (1.0\ \text{cal./ml.}\ ^{\circ}\text{C}) \times$ _____ °C x _____ ml = _____ cal.

6. The rest of the energy change in the water causes some of the water to boil. It can be found by . . . .

   $\text{Heat}_2 = (540\ \text{cal./ml.}) \times (V_s)$

   V_s = Your volume of water converted to steam.

   a) Put your result for V_s in the blank and multiply

   $\text{Heat}_2 = (540\ \text{cal./ml.}) \times$ (_____ ml.) = _______ cal.

7. The total energy changes in the water = $\text{Heat}_1 + \text{Heat}_2$

   a) Put in your results for Heat_1 and Heat_2 and add

   Total energy of water = _____ cal + _____ cal = _____ cal.
   (answer #5a) (answer #6a)

8. It is this total energy of water which causes the pinwheel to spin.

   a) Into what form of energy is the heat energy from the boiling water being converted as the pinwheel spins? _______________

   b) The relationship between the conversion of the energy in the water to the energy in the pinwheel is found by . . . .

   Energy conversion = Total energy of water ÷
   (answer #7)

   Average revolutions per minute
   (answer #3b)

   c) Put in your answers and divide:

   Energy conversion = _____ cal ÷ _____ rpm = _______cal/rpm

B. Class Data

Do this: Copy from the board the total data from All Teams, then average each group findings in the chart below.

Groups

Teams	A(30 ml)	B (40 ml)	C (50 ml)
1			
2			
3			
4			
5			
6			
7			
Calculate Average RPM for Each Group Here...			

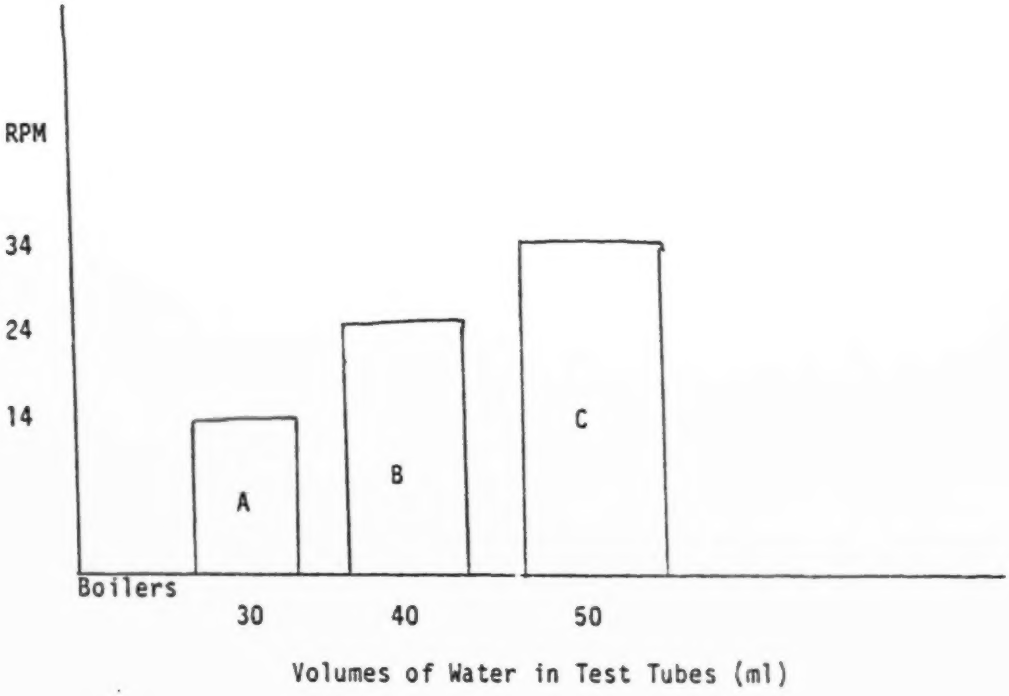
C. Make Bar Graph from the class averages.

I. Refer to your graph technique checklist.

II. Copy from the blackboard the appropriate titles and numerical scale for completing your graph.

C. Teacher's Graph (Students will copy from)

Title: Pinwheel Turns (RPM) as Related to Volumes of Water



D. Homework Questions

Using the finished graphs students will complete these questions:

1. What volume of water resulted in the least RPM? _____
2. What boiler would you want to run your pinwheel? _____. Explain why.
3. Does all the energy from the burning lamp go to heat the water? _____
4. Does all the energy in the steam go to turn the pinwheel? ____
5. If not, explain where the rest of the energy goes in

   question (3).

   question (4) .

6. Can you think of any way we could improve on the method of measuring energy conversion? _______, Explain your answer!

7. To what practical application could this steam engine be put?

8. Name the unit of measurement that is used to express the amount of heat in this activity? ________

9. Do you know the name of other units for measuring energy? ____. Try to list some. _____________________________

10. After having done this activity, describe energy?

Activity 3A Heat Energy Converted To Mechanical Energy (Modified Procedure)

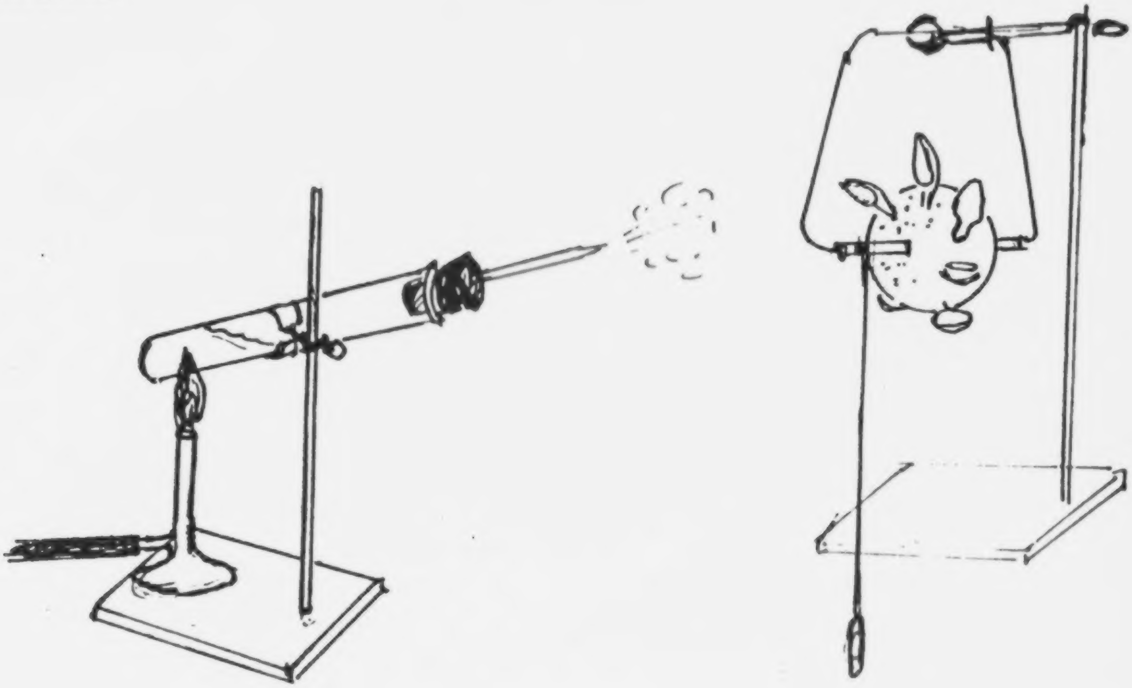
Materials:

2 ring stands, 2 buret clamps, 1 large test tube, 1 one hole stopper to fit test tube, 1 micropipette, 1 each-large (2.5 " in diameter) and small styrofoam balls, 6 or 8 plastic spoons, 1 wire coat hanger, 2 glass droppers, thread, paperclips, bunsen burner or good source of heat, 1 small stopper.

Procedures:

1. Fill a large test tube with about 50 ml of water.
2. Place a piece of glass tubing that has been heated and drawn to a fine opening into a one-hole stopper. Place the stopper into the test tube. This is a steam generator.
3. Straighten a wire coat hanger and cut a 30 cm length. Push the hanger through the center of the large styrofoam ball.
4. Remove it from the ball and bend it into a U shape with the bottom of the U wider than the ball.
5. Into the holes made by the hanger, place two glass droppers that have the rubber squeezer removed. Put them in tip first until they are wedged firmly.
6. Cut 6-8 plastic spoons so that only 1" of each handle remains.
7. Insert the cut end of each spoon into the large styrofoam ball. The spoons should all face in the same direction and be evenly distributed around the circumference of the ball. (The spoons will act as turbine blades.) (See diagram on page 26.)
8. Bend the ends of the hanger at the top of the U about 1 cm toward the U. These should fit into the droppers that were inserted into the ball. The ball should now rotate smoothly while you hold the hanger.
9. The hanger can now be clamped to the ring stand by placing a small stopper and the bottom part of the U of the hanger into the buret clamp.
10. Tie one end of a long thread to a paper clip and the other end tightly to one of the eye dropper tubes.
11. Boil the water in the test tube using a burner and direct the jet of steam into the bowls of the spoons in order to spin the turbine.
12. As the turbine spins the paper clip(s) should be lifted.

Diagram:



Questions For Discussion:

1. How does water move a paper clip?

2. How could you redesign your apparatus to be more efficient?

3. How does gasoline move a car?

4. What other types of jobs could a steam turbine do?

5. Why aren't turbine engines used in automobiles?

6. What is meant by energy conversion?

7. How could water help produce electricity?

8. Why do some paper clips move faster than others?

9. Could water be used as a fuel? Explain.

Some Pre/Post Questions:

Pre/Post Test

Fuel is a kind of _________ energy

a) mechanical
b) chemical
c) gravitational

The fuel ___________ and produces _______________

a) burns, heat
b) decomposes, water
c) distintigrates, air

Water __________ and produces ________________

a) condenses, ice
b) evaporates, air
c) boils, steam

The turning ball is a kind of ____________ energy

a) chemical
b) potential
c) mechanical

This machine is called a _________________

a) magnetic wheel
b) steam turbine
c) gasoline engine

In this experiment _______________ energy is changed to ___________ energy

a) light, electrical
b) chemical, mechanical
c) heat, light

Some Pre/Post Questions:

Pre/Post Test, Continued

Classifying forms of energy:

a) turning turbine
b) flame
c) brazil nut
d) hot plate
e) winding string
f) burning fuel
g) methane qas (in burner)
h) lifting paper clip
i) alcohol

....

Put letter by correct energy form

Chemical energy

Heat energy

Mechanical energy

Use terms to complete sentences:

Heat
Steam
Steam turbine
Fuel
Mechanical energy

A machine called a _____________ ______________ is often used to produce large amounts of electricity.

___________________ is burned to produce _________________.

Water is changed to ______________________.

The 'blades' of the turbine turn producing ________________ ____________ which can be used to move objects.

Activity 4 Energy Conversions

Objectives: Students should be able to:

1) construct simple circuits.

2) infer through experimentatin that chemical energy is converted to electrical energy in a dry cell.

3) demonstrate experimentally how electrical energy can be converted to heat and light energy

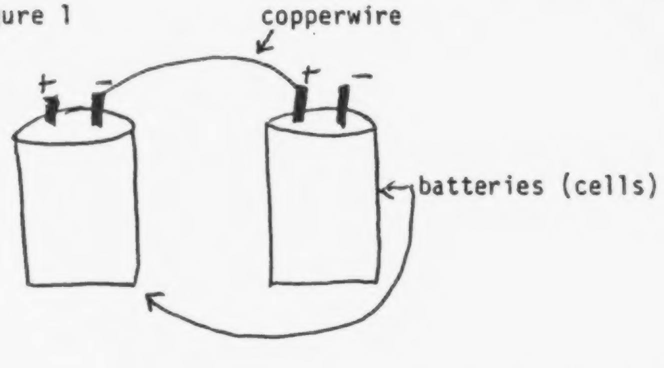
4) construct a data table and graph the results.

Materials:

2-1.5V dry cells, copper connecting wire, Nichrome wire (2 inches), Styrofoam cups (two sizes), thermometer or thermistor, ceramic light socket, light bulb, knife switch, 1 ring stand, test tube clamp with one hole stopper for thermometer tape to secure cups.

Procedures: 1. Using the copper wire connect the cells in series. To connect in series, see Figure 1.

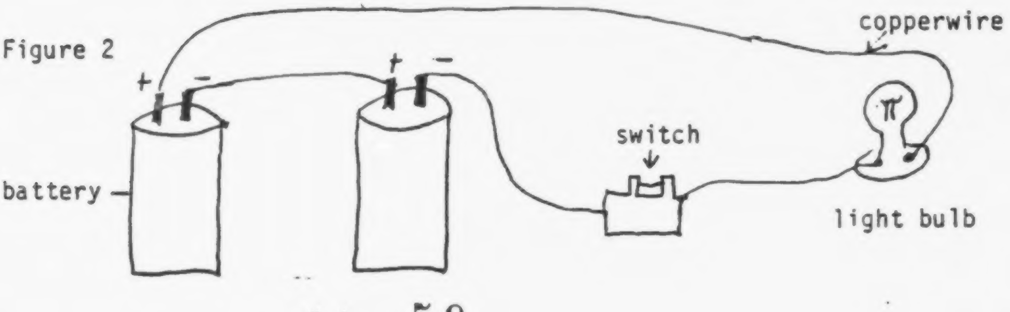
Figure 1



IMPORTANT
When connecting cells in series, always connect opposite terminals.

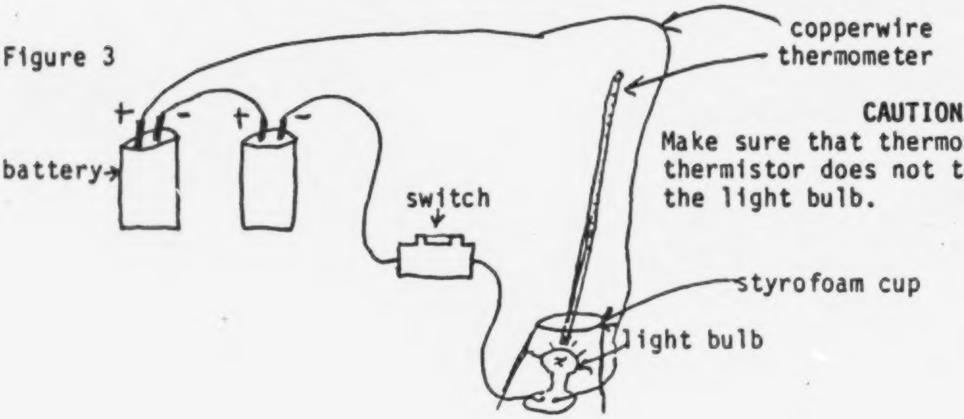
2. Construct a circuit using two cells in series and the light bulb in the ceramic base, and the knife switch. See Figure 2.

Figure 2



3. Cover the light bulb with a 6 oz. Styrofoam cup containing a thermometer or thermistor. See Figure 3.

Figure 3


copperwire
thermometer
+
-
+
-
battery
switch
styrofoam cup
light bulb

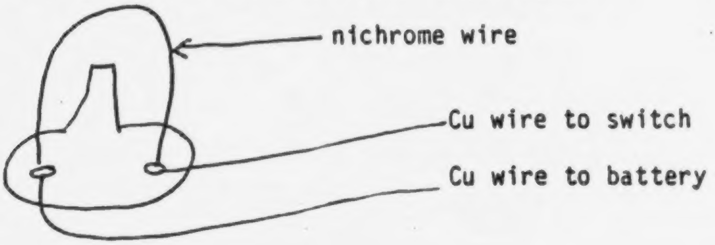
CAUTION
Make sure that thermometer/thermistor does not touch the light bulb.

4. Complete the data chart.

Time (sec)	Temperature (°C)
0	
15	
30	
45	
60	
75	
90	
105	
120	
135	
150	

5. Open the knife switch and remove the light bulb from the socket. Place a piece of Nichrome wire across the socket and attach to the terminals. See Figure 4

Figure 4


nichrome wire
Cu wire to switch
Cu wire to battery

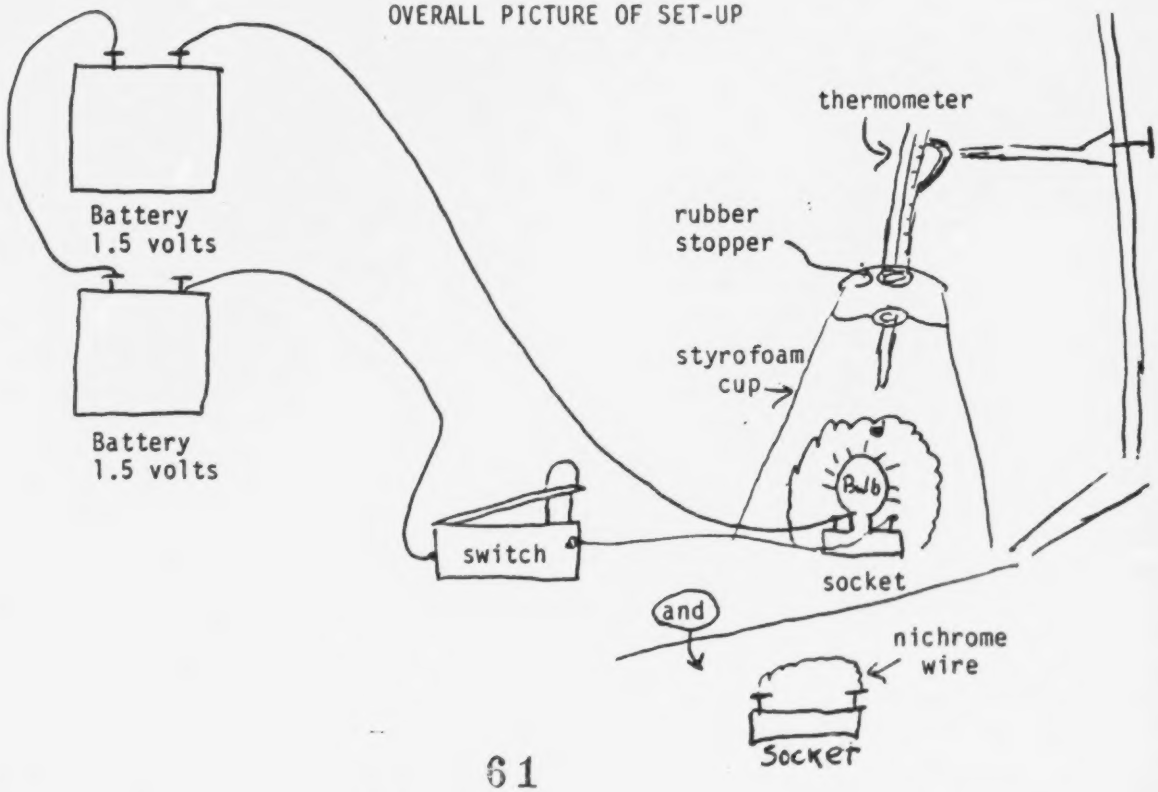
6. Cover the Nichrome wire/socket arrangement with the previously prepared cup and thermometr/thermistor.

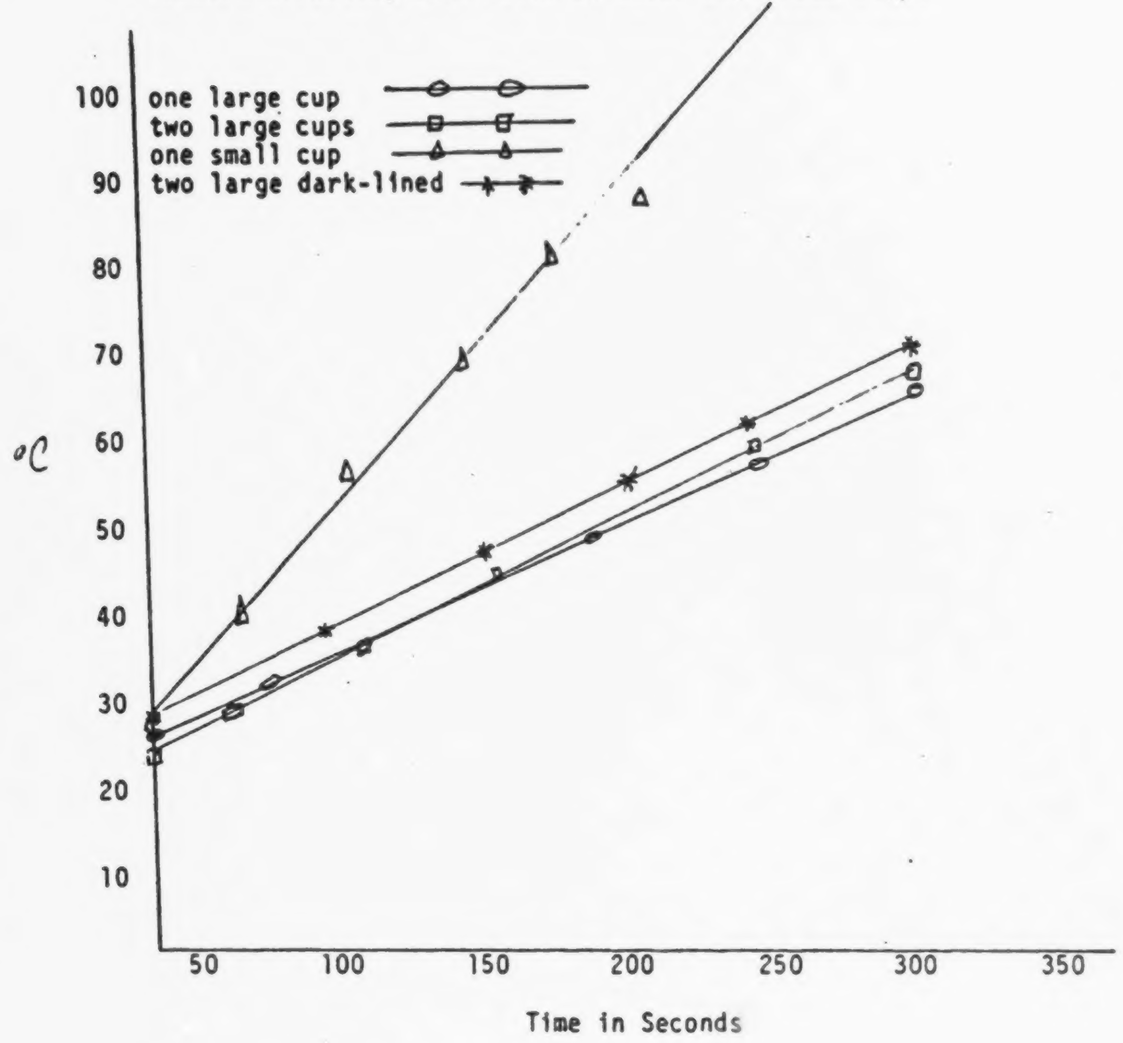
7. Complete the correctly titled data sheet.

8. Open the knife switch and replace the 6 oz. cup with a smaller cup. Repeat data collection and recording.

Calculations Graph the data using temperature on the vertical axis and time on the horizontal axis. Place all three sets of data on the same pair of axes.
Be sure to use the graphing checklist when constructing your graph.

OVERALL PICTURE OF SET-UP


thermometer
Battery
1.5 volts
rubber
stopper
styrofoam
cup
Battery
1.5 volts
Bulb
switch
socket
and
nichrome
wire
Socket


Factors effecting heat build-up under styrofoam cups!

Interfacing with the Thermistor:

TO THE INSTRUCTOR:

Constructing a thermistor may appear to be a difficult activity for 9th graders, please be advised of the following suggestions.

1. Construct and calibrate a thermistor on your own (15 to 20 minutes)
2. Under take the activity in a slow, sequential manner.
3. Increase students self esteem by liberal use of positive reinforcement and one on one interaction.
4. You will find, that your thermistor has the following use:
    - a) Weather report, indoor and outdoors
    - b) Students temperature, arm, fingertips, armpits, nostral breathing.
    - c) Text book use (Merrill General Science, Activity pages 62, 147, 237, 238, 362, 562, and 569.

Questions

Complete the following questions based on your knowledge of energy conversions.

1. The battery contains ______________________________ energy.

2. The battery converts _________________ energy to ________________ energy.

3. The light bulb converts _______________ energy to ________________ and _______________________ energy.

4. The Nichrome wire converts ____________________ energy to _________________ energy.

5. Which experiment produced the most heat as measured by the change in temperature?

6. Which experiment produced the least heat as measured by the change in temperature?

7. Why does the Nichrome wire produce more heat than the light bulb?

8. Why does the temperature increase more with the smaller cup than with the larger cup?

9. **Optional** - Design an experiment using the same materials that would test a different variable.

10. **Optional** - Actually run the experiment that you have designed in question #9, setting up your own data chart and graph.

"MAKING A THERMISTOR"

Microcomputer Lab Interface

Objectives: Students should be able to:

1. Construct a thermistor
2. Calibrate a thermistor
3. Collect data using a microcomputer/thermistor interface.

Materials:

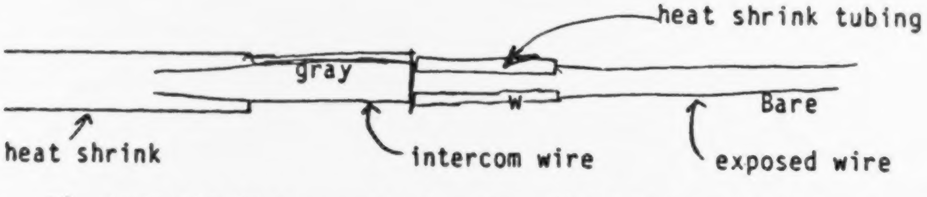
Heat-shrink tubing 12 cm (5/16"), 4 cm (1/8")
Intercom wire (Z wire)
Seraphim program - lab module for teacher (directions for making the thermistor probe)
wire stripper
flax core solder
Bunsen burners
hot plate
dropper
thermistor 0-100°C

Procedure:

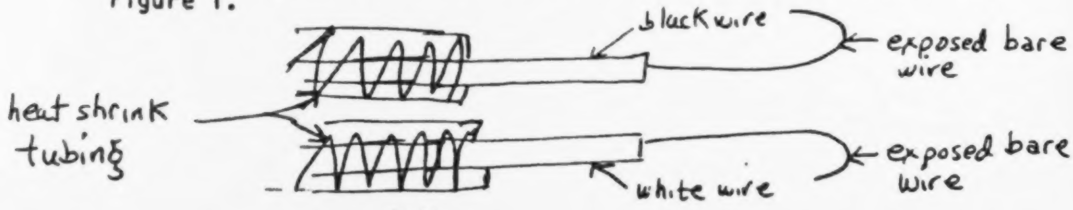
1. Measure to obtain 1.6m intercom wire.
2. Strip 10 cm off each end of the wire (casing)
3. On the exposed wire (black & white) strip off 3 cm.
4. Place 12 cm of 5/16" heat shrink tubing on the intercome wire casing.
5. Place 4 cm of 1/8" heat shrink on the black wire and 4 cm of 1/8" heat shrink on the wire.

see Fig. 1

Figure 1


heat shrink tubing
gray
w
Bare
heat shrink
intercom wire
exposed wire

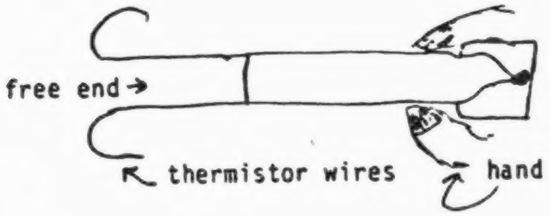
b) Loop the bare copper wire from the black and white wire - See Figure 1.


black wire
exposed bare wire
heat shrink tubing
exposed bare wire
white wire

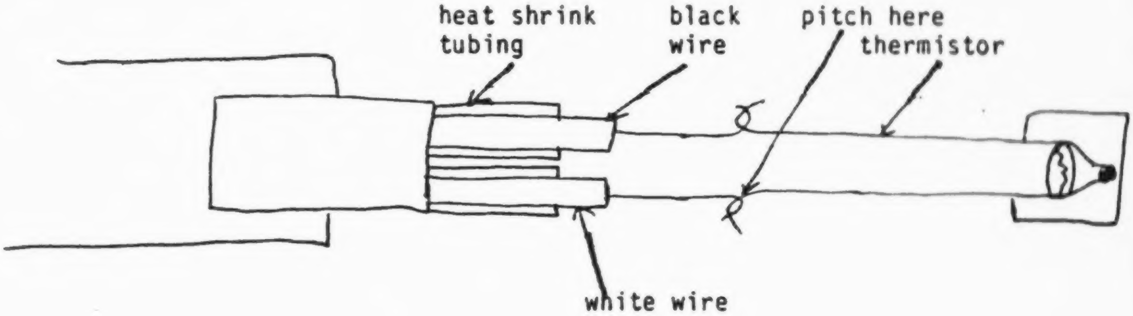
7) Obtain a thermistor.

CAUTION
1) The thermistor is very fragile.
2) Do not twist the wire near the glass.

8) Hold the thermistor wires at approximately the midpoint, loop the free ends of each thermistor wire (see below).


free end
thermistor wires
hand

9) Interloop the Z loops of the thermistor with the loops of the black and white wire. Pitch the 2 pairs of wires together securely.


heat shrink tubing
black wire
pitch here
thermistor
white wire

Optional. Teacher solders connection

10) Carefully pull the 1/8" heat shrink tubing over the connections to the glass part of the thermistor.
CAUTION: When the heat shrink tubing is pulled up be sure that exposed wires do not touch each other.

11) Obtain an alcohol burner

12) Hold the thermistor by the glass. Place the 1/8" heat shrink wire over the burner and shrink the wire.

13) After cooling, pull the 5/16" heat shrink wire over the 1/8" heat shrink wire until you come in contact with the glass part of the thermistor.

14) Place over burners and heat shrink. **Caution:** Be sure to hold the thermistor by the glass **(your fingers will serve as a heat sink to protect the thermistor).**

15) Obtain 3/8" diameter heat shrink tube, 7.5 cm long.

16) Place the tubing over the intercome wire.

17) Obtain a sealed dropper and place it over the thermistor.

18) Pull the tubing over the base of the dropper and seal by heat shrinking.

CALIBRATING THE THERMISTOR

It is necessary for the thermistor to be carefully calibrated to establish range, precision, and accuracy.

This simple exercise represents a good illustration of the basic aspects of modern instrument calibration.

Materials:

Thermistor
2 - 250 ml beakers
Hg thermometer
heat source
H_2O
ice

Procedure

1. Place 150 ml of water in 1 beaker with ice.

2. Place 200 ml of water in the other beaker and place on heat source. Heat to 80°C.

3. While water is heating and cooling, load #1203 seraphin diskette into the microcomputer, following your teacher's instructions.

4. On the primary menu, select option 2, press return, option 6, press return, option 2, press return.

Available Computer Enrichment Materials

Software that supplement the four units are available for preview at the University of Pittsburgh Regional Computer Center, 1N10 Forbes Quad. Programs there can be viewed by any teacher. A brief recommended list of such software follows:

1. "Sunburst Communication: Discover, A Science Experience."
    - a. Improves student note taking and observational skills.
    - b. Helps students analyze and interpret data.
    - c. Helps students formulate hypotheses from data selected.
    - d. Aids students in testing hypotheses.
    - e. Helps students in testing outcomes.

2. "Volcanoes, Blue Book"
    - a. Helps students keep records.
    - b. Aids students in interpretation of scientific observations.
    - c. Helps students understand maps.
    - d. Introduces students to Cartesian Coordinates.
    - e. Aids students in the interpretation of histograms.

3. "Making Circuits"
    - a. Helps students construct both series and parallel electrical circuits.
    - b. Uses students to measure, predict, and infer outcomes.
    - c. Directs students to conduct simple experiments.
    - d. Helps students arrange objects in sequences.

4. "Energy Search"
    - a. Helps students stimulate problem solving using various forms of power such as animals, wood, oil, nuclear and solar power. Students are made to solve energy problems.
    - b. Introduces to students both independent and dependent variables, helps students answer questions about energy, and helps students infer by grouping.

5. "Relevant Reading Through Science"
    - a. Reading paragraphs are presented that have various reading levels -level III, written for grades 5 and 6 and level IV written for grades 7 and 8. The questions that follow the readings are based upon various kinds of comprehension skills.

6. "The voyage of the MIMI," Bank Street Laboratory
    - a. Helps students measure, compare, calibrate, and graph temperature, light, sound, loudness, frequency, etc.
    - b. Directs students to interpret a sound scope where one and two waves are magnified.
    - c. Provides students with experiments in timers, autometers, speed of sound and the use of speakers.

7. "HRM Experiments in Chemistry"
   a. Introduces to students measurement of cooling curves, specific heat of metal, freezing point depression, heat neutralization, along with other basic measurements.

8. "Project Seraphim"
   a. Directs the students to make, calibrate and use of Thermistor Probes.
   b. Helps students make and use PH Probes.
   c. Helps students construct and learn to use a Blocktronics in the measurement of light intensity.

PITTSBURGH STS PROJECT

TEACHER EVALUATION FORM

Name ______________________________ Module: Intro A 1 2 3 4 (circle one)

School ____________________________

Activity Title & Number ____ ______________________

Grade Level _______________________

Please ANSWER EACH OF THE FOLLOWING QUESTIONS AT THE COMPLETION OF EACH ACTIVITY. Please comment in more detail on separate pages of paper where appropriate. Circle the most appropriate response.

1. OBJECTIVES

Were the stated objectives clear and accurate?	Excellent	Good	Poor

2. TEACHER BACKGROUND

Was the teacher background accurate?	Excellent	Good	Poor
Was the information provided a sufficient background on the subject?	Excellent	Good	Poor

3. MATERIALS

Was the materials list complete?	Excellent	Good	Poor
Did you have enough of each material required?	Excellent	Good	Poor

*Please indicate any resources, books (teacher or student), equipment, etc. that your recommend for inclusion in future modules.

4. STUDENT ACTIVITY SHEETS

Were the Student Activity Sheets (SAS):

Relevant to the objectives?	Excellent	Good	Poor
Clear and logical?	Excellent	Good	Poor

*Which were the most successful activities?

5. EXTENDED ACTIVITIES

*Have newly acquired decision making skills lead to action on personal problems? Involvement in community organizations? Involvement in local government issues? Other?

6. EVALUATION

What method of student evaluation did you use? (SAS sheet, separate test, etc.?)

*How successful were the students?

7. PROCEDURE

Was the suggested procedure clear and complete?	Excellent	Good	Poor

*Did you follow the suggested procedure? What modifications, if any, did you make?

8. RATE THE FOLLOWING: (circle one)

Student interest	High	Medium	Low
Appropriateness of material for students	High	Medium	Low

9. Do you recommend this activity for future use?

10. Other comments/recommendations:

Teacher signature ______________________ Date ________

Date when Activity was completed ______________________

The PITT STS Project

MODULE II

THE PITTSBURGH SCIENCE TECHNOLOGY SOCIETY PROJECT

SELECTING YOUR DREAM CAR

THE PITTSBURGH SCIENCE TECHNOLOGY SOCIETY PROJECT

MODULE II

SELECTING YOUR DREAM CAR

developed by

Steve Schwab, Sharon Lace, James Metzger
John Sparvero, David Vause, George O'Brien, and Will Korth
with the Inservice Workshop Participants

June, 1988

George O'Brien, Project Director and Series Editor
University of Pittsburgh

THE PITTSBURGH SCIENCE TECHNOLOGY SOCIETY PROJECT

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Module II

Selecting Your Dream Car

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TEACHER EVALUATION FORM -

MODULE II

Selecting Your Dream Car

COMPETENCIES

A. Processes

1. Observing
2. Classifying
3. Inferring
5. Measuring
6. Communicating
9. Formulating Hypotheses
8. Defining Operationally
12. Interpreting Data
13. Formulating Models

ACTIVITIES

1. Getting There
2. Selecting a Dream Car
3. Hidden Costs and Cost Per Month
4. Hidden Persuasion

INSTRUCTIONAL OBJECTIVES

At the end of these lessons, each student should be able to:

1. Label a diagram of an automobile (exterior and interior).
2. Choose options for the dream car.
3. Select her/his dream car.
4. Read a data table (finance charges).
5. Realize hidden costs that she/he will have to pay.
6. Get an indication of monthly costs and unexpected costs of a car.
7. Identify different methods used in advertising.
8. Analyze advertisements in terms of valid information presented.

ACTIVITY 1 - Getting There

Objectives: The student should be able to:

1. Label an automobile (exterior and interior)
2. Begin to choose options for the dream car.

Teacher Background: This activity is designed to familiarize the students with the terminology on the option sheets for Activity 2. Have students bring in pictures of American cars (from magazines, newspapers, etc.) showing both interior and exterior views before class day. During the activity, teachers should circulate around the classroom making sure the students are familiar with terms including rear defroster, cruise control, power steering, and lighting packages.

According to the automobile code, front running lights (outside turn signals) are amber and the rear lights are red.

Materials:

Pictures of cars (inside and out)

Student Activity Sheets:

SAS 1.1 Exterior drawing of the car

SAS 1.2 Interior drawing of the car

Procedure:

1. Pass out pictures of automobiles and parts.
2. Pass out blank student activity sheets.
3. Have students identify and label the blanks, indicate by "*" which are options to be chosen by the buyer.

Extra Activities or Homework

1. SAS 1.3 Scrambled letter sheet - My Dream Car
2. For alternate activity, have the students number the rows and

columns of the scrambled letter sheet. (They can be numbered or letters - your choice).

3. Locate the word, circle the word, list the coordinates of the first letter of the word, and indicate the direction that the word is written in terms of compass headings (N, S, E, W, NW, NE, etc.).

CAR EXTERIOR

1

2

3

4

5

6

7

8

9

10

11

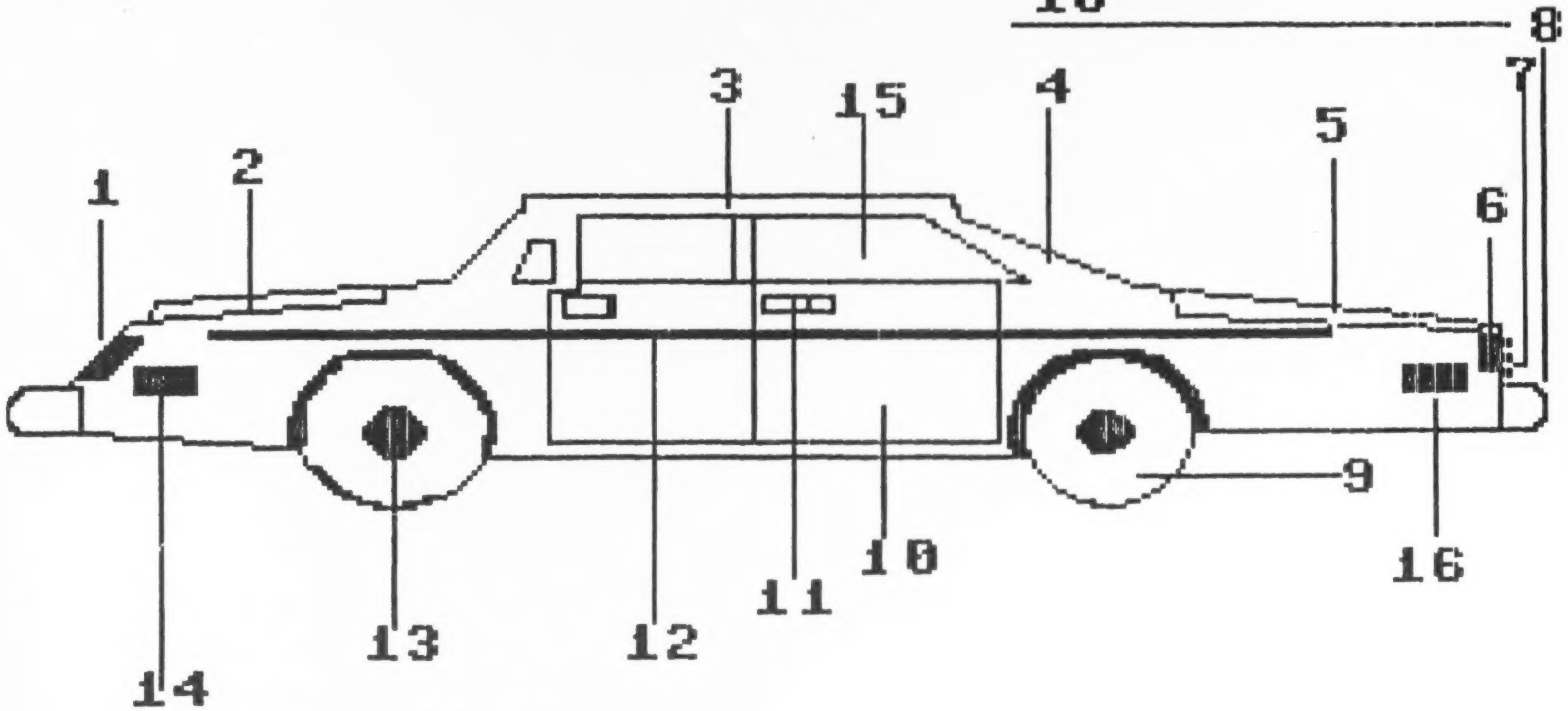
12

13

14

15

16


1
2
3
15
4
5
6
7
8
9
10
11
12
13
14
16

II.

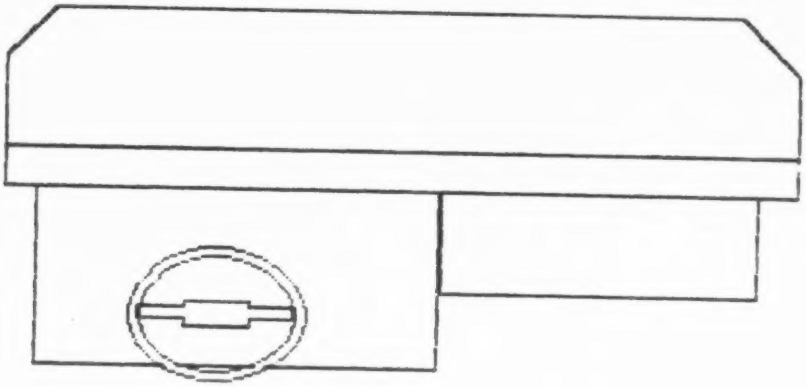
CAR INTERIOR

1. What is the function of each of the following part of the dashboard?

    1. speedometer
    2. voltage guage
    3. turn signal indicator
    4. odometer
    5. seat belt light
    6. wipers
    7. brake light
    8. radio
    9. temperature guage
    10. glove box
    11. horn
    12. gas guage
    13. radio
    14. light switch

2. Place each item listed above on the dashboard below, in the place where you usually see it.

3. Place additional features that you may have seen or know of that are not listed.



II.

MY DREAM CAR

U	K	Y	S	N	O	T	S	I	P	B	S	T	E	K	C	U	B	K	B
R	Z	R	P	O	O	G	A	U	N	L	E	A	D	E	D	R	O	O	F
E	V	E	E	I	L	Z	H	A	F	I	B	E	R	G	L	A	S	S	W
T	T	T	L	T	S	D	L	E	I	H	S	D	N	I	W	O	F	G	Y
L	Y	T	B	I	F	C	A	R	P	O	O	L	B	R	A	K	E	S	R
I	C	A	I	N	N	L	A	L	I	G	N	M	E	N	T	S	G	U	K
F	I	B	T	G	I	Q	A	C	A	R	B	U	R	E	T	O	R	Y	T
L	T	R	R	I	D	Z	H	I	C	S	S	C	A	M	S	H	A	F	T
Y	A	E	E	C	L	O	U	R	T	T	G	R	P	O	I	N	T	S	B
W	M	L	V	F	O	I	A	D	A	N	L	U	A	U	X	M	T	V	A
H	O	F	N	D	M	N	E	N	E	S	E	U	L	D	O	R	Z	V	E
E	T	F	O	M	K	F	D	X	Y	F	J	R	F	P	I	G	V	L	M
E	U	U	C	S	R	A	H	E	S	A	L	T	E	R	N	A	T	O	R
L	A	M	H	O	R	A	K	D	N	T	G	R	T	F	G	D	L	G	V
G	L	A	S	D	U	R	K	T	F	S	H	A	I	R	F	R	O	S	Q
O	F	T	B	S	R	E	P	M	U	B	E	G	B	M	U	I	I	O	S
T	E	G	T	D	F	S	E	V	L	A	V	R	I	F	S	N	D	L	R
R	C	O	N	S	O	L	E	Q	A	T	Y	T	J	L	M	C	K	F	L
N	O	I	S	S	I	M	S	N	A	R	T	R	A	D	I	A	T	O	R
G	P	D	A	L	T	V	N	G	Z	S	I	W	W	W	U	G	W	S	D

WORD LIST

ALIGNMENT
ALTERNATOR
AUTOMATIC
BATTERY
BRAKES
BUCKETS
BUMPER
CAMSHAFT
CARBURETOR
CARPOOL
CONDENSER
CONSOLE
CONVERTIBLE
CRANKSHAFT
DEFROSTER
DIFFERENTIAL
DOOR
EXHAUST
FIBERGLASS
FILTER
FLYWHEEL
GRILL
HOOD
IGNITION
LIGHTS
MOLDINGS
MUFFLER
PISTONS
PLUGS
POINTS
RADIALS
RADIATOR
RIMS
ROOF
STANDARD
TRANSMISSION
TRUNK
UNLEADED
VALVES
WINDSHIELD

II.

SOLUTION LIST

WORD	ROW	COLUMN	DIR
TRANSMISSION	19	12	W
DIFFERENTIAL	17	18	NW
CONVERTIBLE	13	4	N
CARBURETOR	7	9	E
ALTERNATOR	13	11	E
WINDSHIELD	4	16	W
FIBERGLASS	3	10	E
CRANKSHAFT	8	10	SW
AUTOMATIC	14	2	N
CONDENSER	9	5	SE
ALIGNMENT	6	8	E
DEFROSTER	10	9	SW
MOLDINGS	11	6	N
STANDARD	8	12	SW
UNLEADED	2	9	E
RADIATOR	19	13	E
FLYWHEEL	7	1	S
IGNITION	8	5	N
CAMSHAFT	8	13	E
CARPOOL	5	7	E
BUCKETS	1	18	W
EXHAUST	11	10	SW
CONSOLE	18	2	E
PISTONS	1	10	W
RADIALS	9	13	SE
MUFFLER	14	3	N
BATTERY	7	3	N
BRAKES	5	14	E
LIGHTS	18	15	NW
POINTS	9	14	E
VALVES	17	12	W
BUMPER	16	11	W
FILTER	7	1	N
PLUGS	12	15	NW
TRUNK	14	14	SE
GRILL	14	16	SE
DOOR	14	17	SE
RIMS	14	13	SE
ROOF	2	17	E
HOOD	8	8	SW

ACTIVITY 2. Selecting a Dream Car

Objectives: The student will choose their own dream car.

Teacher Background: Discuss with the students cars they have seen, cars their parents drive or cars they drive. Have pictures of various cars around the room and available to pass around. Discuss what car they would like to have and play "What if...".

Materials: Pictures of cars and parts.

Student Activity Sheets:

SAS 2.1 Dream Car (options)

Suggested Procedures:

1. Pass out pictures of cars, parts, etc.
2. Pass out dream car option sheet (See SAS 2.1).
3. Have students pick their cars, options and accessories and check the options they want.

II.

SAS 2.1

DREAM CAR

NAME: ______________________________

MAKE: ______________________________

MODEL: ______________________________

		COST
AUTOMATIC OR STICK		
POWER BRAKES AND STEERING		
AM/FM RADIO		
POWER SEATS		
AIR CONDITIONING (tinted glass)		
SPORTS PACKAGE (suspension & steering)		
SPECIAL PAINT		
REAR DEFROSTERING		
CRUISE CONTROL		
STANDARD OR SPECIAL ENGINE		
SUNROOF/CONVERTIBLE		
CLOTH/VINYL SEATS		
LIGHTING PACKAGE		
OTHER OPTIONS		
	TOTAL COST	

ACTIVITY 3. Hidden Costs and Cost Per Month

Objectives: The student should be able to:

1. Read a data table (finance charges).
2. Realize hidden costs they will have to pay.
3. Get an indication of monthly costs and unexpected costs of a car.

Teacher Background: Using the Dream Car option sheet the students will get a total cost for their car, determine their finance charge, charges for other costs, and monthly charges. With further discussion, salary and types of job needed to afford the car might be determined.

Student Activity Sheets:

SAS 3.1	Retail Price Sheet
SAS 3.2	Finance Charge 9.9% - 48 months
SAS 3.3	Hidden Cost Sheets
SAS 3.4	Dream Car - Option Costs
SAS 3.5	Questions

Suggested Activities:

1. Role playing the scenario of a car theft (see Question #11 of SAS 3.5).

II.

SAS 3.1

RETAIL PRICE SHEET

AMERICAN MOTORS		MPG
Alliance Sedan	6800	32
Alliance Convertible	11000	24
Eagle	11500	18
Encore	7000	26

BUICK		
Century	11000	20
Electra	16000	19
Electra Wagon	16000	16
Regal	11000	17
Skyhawk	8300	23
Somerset	10000	23
LeSabre	13000	19
Riveria	20000	19

CADILLAC		
Deville	20000	17
El Dorado	24000	17
Seville	20000	17
Cimarron	13000	22

CHEVROLET		
Camaro	11900	17
Caprice	1100	19
Cavalier	7000	22
Celebrity	9000	20
Chevette	6000	28
Corvette	27000	17
Monte Carlo	12000	18
Nova	7500	29

CHRYSLER		
5th Avenue	15000	16
Lebaron	1000	23
New Yorker	13000	20

DODGE		
600	10000	23
Aries	8000	24
Charger	8000	28
Daytona	10000	23
Diplomat	10500	16
Lancer	10000	23

FORD		MPG
Escort	7000	27
LTD	10000	20
Mustang	12000	20
Tempo	8000	36
Thunderbird	12000	19
Taurus	11000	22

LINCOLN		
Continental	25000	18
Mark VII	23000	18
Town Car	24000	18

MERCURY		
Capri	9000	21
Cougar	13000	19
Grand Marquis	14000	18
Lynx	8000	32
Marquis	10000	21
Topaz	9000	36
Sable	12000	22

OLDSMOBILE		
Calais	9500	23
Cutlass	10500	20
Firenza	9000	22
98 Regency	16000	19
Delta 88	130000	19
Torando	19500	19

PLYMOUTH		
Caravelle	9500	22
Gran Fury	10000	16
Horizon	7000	27
Reliant	7500	24

PONTIAC		
1000	6000	27
6000	10000	19
6000 STE	16000	19
Bonneville	11000	18
Fiero	9500	24
Firebird	12000	19
Grand Am	9500	20
Grand Prix	11000	18
Parisienne	11500	18
Sunbird	10000	24

II.

SAS 3.2

Finance Charges ($)

	19.9% for 48 months		10.9% for 60 months	
Cost	Per Month	Total Cost	Per Month	Total Cost
8000.00	215.20	10329.60	182.40	10944.00
9000.00	242.10	11620.00	205.20	12312.00
10000.00	269.00	12912.00	228.00	13680.00
11000.00	295.90	14203.20	250.80	15048.00
12000.00	322.80	15494.40	273.60	16416.00
13000.00	349.70	16785.60	296.40	17784.00
14000.00	376.60	18076.80	319.20	19152.00
15000.00	403.50	19368.00	342.00	20520.00
16000.00	430.40	20659.20	364.80	21888.00
17000.00	457.30	21950.40	387.60	23256.00
18000.00	484.20	23241.60	410.40	26624.00
19000.00	511.10	24532.00	433.20	25992.00
20000.00	538.00	25824.00	456.00	27360.00
21000.00	564.90	27115.20	478.80	28728.00
22000.00	591.80	28406.40	501.60	30096.00
23000.00	618.70	29697.00	524.40	31464.00
24000.00	645.60	30988.80	557.20	32832.00
25000.00	672.50	32280.00	570.00	34200.00
26000.00	699.40	33571.20	592.80	35568.00
27000.00	726.30	34862.40	615.60	36936.00
28000.00	753.20	36153.60	638.40	38304.00
29000.00	780.10	37444.80	661.20	39672.00
30000.00	807.00	38736.00	684.00	41040.00
31000.00	833.90	40027.20	706.80	42408.00
32000.00	860.80	41318.40	729.60	43776.00
33000.00	887.70	42609.60	752.40	45144.00
34000.00	914.60	43900.89	775.20	46512.00

II.

HIDDEN COSTS

TOTAL COST OF CAR ____________________

FINANCING: Rate __________
Years __________ ____________________

COSTS PER MONTH

FINANCING ____________________

GAS (ASSUME 250 MILES TRAVELED A WEEK.
AT $1.00 A GALLON.
FIND MILEAGE AND DIVIDE INTO 250.
THIS GIVES GALLONS USED X $1.00= ____________________

OIL CHANGE ____________________

TUNE-UP ____________________

INSPECTION AND EMISSION (TOTAL DIVIDED BY 12) ____________________

INSURANCE (RATE DIVIDED BY 12) ____________________

REGISTRATION, LICENSE AND CAT ____________________

TOTAL COST PER MONTH ____________________

II.

SAS 3.4

DREAM CAR - OPTIONS COSTS

AUTOMATIC OR STICK	275
POWER BRAKES AND STEERING	125
AM/FM RADIO	150
POWER SEATS	100
AIR CONDITIONING (TINTED GLASS)	650
SPORTS PACKAGE (SUSPENS & STEERING)	1,225
SPECIAL PAINT	100
REAR DEFROSTERING	75
CRUISE CONTROL	75
STANDARD OR SPECIAL ENGINE	150
SUNROOF/CONVERTIBLE	150/525
CLOTH/VINYL SEATS	0/175
LIGHTING PACKAGE	125
OTHER OPTIONS	
____________________	____________________
____________________	____________________
____________________	____________________
____________________	____________________

QUESTIONS

1. List as many other costs, not mentioned on the data table, on the hidden cost sheet.

2. Place an approximate cost per month next to each item on the sheet.

3. What would you have to earn each month in order to afford the car you chose and for other expenses?

4. What is this salary for a year?

5. What types of jobs would allow you to have your automobile?

6. Having answered Questions 1 - 5, do you still believe you can purchase the same dream car with the same options?

7. Are there any changes you could make in your lives to help obtain your dream car?

8. If not, would you change your choice of cars? If so, to what car?

9. Are there any options that you chose that you could or should do without?

10. Are there any ways that you can reduce the maintenance costs of your car?

11. You have just paid off your car, and it is stolen. What happens now? What procedures do you have to follow and how is your personal life affected?

II.

SAS 3.6

SUPERFLITE

It is the year 2020! SUPERFLITE CARS MFG. have developed an automobile that flies. How will this invention impact our society? What if you are the designer of a SUPERFLITE car? What would the vehicle look like? Your major objective in this assignment is to set up guidelines that relate to the question: How will this auto impact the development of our society? You will work in teams of three.

Possible avenues to explore include:

1. design of the car- number of passengers, speed, necessary safety features, etc.?
2. where could it go- homes, airports, where?
3. rules and regulations?
4. impact on recreation- where can you go in one day?
5. impact on the environment?
6. conflicts with existing rules of society?
7. legal implications- where to take off from, littering, etc.?
8. where to put (service) stations- how far apart, zoning laws, planning committee?
9. interior of the car?
10. safety items?
11. international travel customs, smuggling, etc.?
12. advertising- design of car?
13. effects on dating and other social recreational activities?
14. law enforcement- where would police pull you over?
15. bathrooms, emergencies?
16. vocabulary for this new invention?
17. impact on railroads, airlines, businesses?
18. discuss the possible technical aspects of the power train, lift, shape, etc.?

This can be assigned as an inclass project (for example over 5 class periods), or as an independent take home assignment. Each person or group might give an oral presentation of their report. The report should include guidelines to the company, customer, legal system, and the public (innocent bystander).

Extension:

Build your SUPERFLITE vehicle. Design as a competition with a prize or prizes for the most imaginative, creative, technical, practical, etc. design.

ACTIVITY 4. Hidden Persuasion

Objectives: The students should be able to:

1. identify different methods used in advertising.
2. analyze advertisements in terms of valid information presented.

Teacher Background:

The major portion of the financing of television and radio programs comes from commercial advertising. But some commercials tell very little about the product that they advertise. Terms like softer, lighter, smoother may be used to compare a product with that of a competitor. Qualitative adjectives give no clear evidence that one product is better than another. A more accurate presentation would be a quantitative statement of how much softer, lighter, or smoother is a product versus another product.

Some commercials use a catchy slogan or song or have famous persons endorsing the product. Frequently, the slogan or song gives no indication of the worth of the product being advertised. People who endorse a product are paid well to say only good things about it. Describe some other selling methods used in commercials that fail to inform the buyer of the true nature of the product.

A questioning mind is one of the characteristics of a scientist. A questioning mind can be important for everyone, when deciding which products to buy. If people carefully examine and question information about a specific product, it is possible that they may buy more wisely. They would be able to distinguish real evidence from meaningless words.

The words used in the student activity are defined on SAS 4.2. Have students bring in 5 advertisements from magazines or other sources that are in color for discussion.

Bear in mind techniques such as sexual attitude, color of car, angle of photography, background, dress, age, sex, education and mannerism of presentor, promotional devices, and time shown during the day.

Student Activity Sheets:

SAS 4.1	Consumer goods guide
SAS 4.2	Definition of terms
SAS 4.3	Commerical study
SAS 4.4	Questions

Procedures:

1. Select 5 commercials from radio or Television.
2. Study each commercial using the consumer goods guide. The four categories of the guide are explained on the definition sheet. You may not need to use all the categories for each commercial. This will depend on the design of the commericals you select.
3. Using the letters A, B, C from the consumer goods guide, record the presentation, situation, theme and facts presented for each commercial on the Commercial study sheet.
4. Study 5 advertisements from the magazines or newspapers that you brought in. Number each advertisement in the upper right hand corner.
5. What items caught your eye from the first advertisement? What moods does the picture give you? Look at the background. What situation is presented? Does it give a hidden message? Are there people in the picture? How are they dressed? What are they doing? Do the colors in the picture give you a feeling? What feeling do you have after

looking at the picture?

6. Write a short paragraph answering the questions above. Also, add any other observations inferences or feelings you get from each picture.

Possible Future Activities

1. Have the students make a commercial, trying to use the five elements used in advertising - attention, confidence, desire, urgency, response.
2. Video tape several very good commercials in terms of the four elements on the consumer goods guide.
3. Take several commercials demonstrating the 5 parts of a good commercial in terms of the 5 advertising elements.
4. Use these tapes as a class discussion, and have the students pick out the various elements.
5. Game - "Propaganda" - manufactured by Maple-Packers, Turtle Creek, PA.

Resource Materials

"The Pitch," Hugh Rank, Counter - Propaganda Press, 1982.

II.

SAS 4.1

Consumer Goods Guide

Commerical	A	B	C
1. Situation	Realistic	Semi-Realistic	Unrealistic
2. Presentation	Endorsed by famous person	Designed to make viewer/ listener laugh	Other
3. Theme	Slogan	Song	Other
4. Facts Presented	Sound facts presented	A mixture of facts & nonfacts	No facts presented

II.

Definition of Terms

Situation: Is the situation in the commercial realistic, does it fit our everyday experiences, or unrealistic, with characters such as talking animals, miniature people or dream like situations?

Presentation: Is the product endorsed by a famous person? Is the commercial designed only to make people laugh? Neither tells much about the true quality or effectiveness of the product.

Theme: Is there a song or slogan used in the commercial? Neither gives much information about the commercial, but these hooks tend to make us remember the product.

Facts Presented: Does the commercial present factual material such a cost, weight, or other measurable facts to show that the product is better than another? Or are words such as softer, lighter, or smoother used to describe the product?

SAS 4.3

II.

Commercial Sheet

Product Advertised	Situation	Presentation	Theme	Facts Presented
1.				
2.				
3.				
4.				
5.				

II.

QUESTIONS

1. Based on the commercials that you saw, which products might you decide to buy? What was it about the commercial that convinced you?

2. Which commercial gave the most factual information?

3. Which commercial did you like the most? Why?

4. Were the answers to Questions 2 and 3 the same or different? Explain.

5. Make a general statement about the effectiveness of the commercials that you studied.

6. What adjectives were used to describe the products?

7. What words were used to compare the two products?

8. Does the name of the product bring out certain impressions for you?

9. Advertising usually has 5 parts: 1) attention getting, 2) confidence-building, 3) desire stimulating, 4) urgency-stressing, 5) response-seeking. Look again at your 5 commercials. Can you pick out any of these parts? For each commercial, list or identify those parts and tell what group of people would be most influenced by the ad.

10. Concerning your dream car, did advertising possibly affect your choice? Can you remember what turned your eye towards that particular car?

11. What properties of cars are used by advertising to make a car more appealing?

Optional Questions:

1. What kinds of materials do you **not** see advertised? Why?

2. Does the name of the product bring out certain impressions for you?

PITTSBURGH STS PROJECT

TEACHER EVALUATION FORM

Name ______________________________

School ______________________________

Grade Level ______________________________

Module: Intro A 1 2 3 4
(circle one)

Activity Title & Number _____
____

Please ANSWER EACH OF THE FOLLOWING QUESTIONS AT THE COMPLETION OF EACH ACTIVITY. Please comment in more detail on separate pages of paper where appropriate. Circle the most appropriate response.

1. OBJECTIVES

Were the stated objectives clear and accurate?	Excellent	Good	Poor

2. TEACHER BACKGROUND

Was the teacher background accurate?	Excellent	Good	Poor
Was the information provided a sufficient background on the subject?	Excellent	Good	Poor

3. MATERIALS

Was the materials list complete?	Excellent	Good	Poor
Did you have enough of each material required?	Excellent	Good	Poor

*Please indicate any resources, books (teacher or student), equipment, etc. that your recommend for inclusion in future modules.

4. STUDENT ACTIVITY SHEETS

Were the Student Activity Sheets (SAS):

Relevant to the objectives?	Excellent	Good	Poor
Clear and logical?	Excellent	Good	Poor

*Which were the most successful activities?

5. EXTENDED ACTIVITIES

*Have newly acquired decision making skills lead to action on personal problems? Involvement in community organizations? Involvement in local government issues? Other?

6. EVALUATION

What method of student evaluation did you use? (SAS sheet, separate test, etc.?)

*How successful were the students?

7. PROCEDURE

Was the suggested procedure clear and complete? Excellent Good Poor

*Did you follow the suggested procedure? What modifications, if any, did you make?

8. RATE THE FOLLOWING: (circle one)

Student interest	High	Medium	Low
Appropriateness of material for students	High	Medium	Low

9. Do you recommend this activity for future use?

10. Other comments/recommendations:

Teacher signature ______________________________ Date __________

Date when Activity was completed ______________________________

The PITTS Project

MODULE III

THE PITTSBURGH SCIENCE TECHNOLOGY SOCIETY PROJECT

TRANSPORTATION AND YOUR COMMUNITY

THE PITTSBURGH SCIENCE TECHNOLOGY SOCIETY PROJECT

MODULE III

TRANSPORTATION AND YOUR COMMUNITY

developed by

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John Sparvero, David Vause, George O'Brien, and Will Korth
with the Inservice Workshop Participants

June, 1988

George O'Brien, Project Director and Series Editor
University of Pittsburgh

THE PITTSBURGH SCIENCE TECHNOLOGY SOCIETY PROJECT

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Module III

Transportation and Your Community

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TEACHER EVALUATION FORM -

MODULE III

Transportation and Your Community

COMPETENCIES

A. Processes

1. Observing
3. Inferring
4. Predicting
5. Measuring
6. Communicating
7. Using Space/Time Relations
9. Formulating Hypotheses
10. Experimenting
11. Recognizing Variables
12. Interpreting Data
13. Formulating Models

ACTIVITIES

1. Making Your Own Map
2. Using a Standard City Map of Pittsburgh
3. Transportation in Urban Environments
4. Getting There
5. Cars and Gas

INSTRUCTIONAL OBJECTIVES

At the end of these lessons, each student should be able to:

1. Make a map depicting the route from his/her home to school.
2. Identify typical routes on a City of Pittsburgh Map.
3. Evaluate identified modes of transportation in terms of energy and environment.
4. Compare different types of transportation in terms of mileage and gas efficiency.
5. Interpret histograms.
6. Recognize the inverse relationship between the mass of a car and the distance traveled.

7. Recognize the direct relationship between mass of a car and fuel consumption.
8. Recognize the direct relationship between fuel consumption and distance traveled.
9. Recognize the direct relationship between force provided and distance traveled.
10. Extrapolate and interpolate a graph.

MODULE III

TRANSPORTATION AND YOUR COMMUNITY

Resources:

Pittsburgh, "At Your Own Risk," September, 1982, pp. 68-81.

The problems concerning transportation on the Ohio River Boulevard is the theme of this article. Dangers on this stretch of road, what causes them, and the fatal results.

Pittsburgh, "Inclines: The Hills Were Alive," May, 1983.

A look at a mode of transportation that was essential to the city and its success 70 years ago.

Pittsburgh, "The Belt System: Slow Route to Nowhere," September, 1983. A critique of the routes designed to direct motorists around Pittsburgh without entering downtown.

Pittsburgh, "The Littlest Subway," January, 1984, pp. 34-40.

A look at Pittsburgh's 1.2 mile subway costing $70 million. Also, what's ahead for future subway transportation in Pittsburgh.

Pittsburgh, "Potholes: Plague of the Highways," March, 1984, pp. 17-18. A profile of the menace that effects the cost of transportation and how it's being handled.

Pittsburgh, "Trolleys: Still rumbling after all these years," May, 1984.

A look at the area's first mass transit system.

Pittsburgh, "The Yellow Behemoth," August, 1984, pp. 30-40. This article focuses on the problems of taxicab service. The Yellow Cab Co. is profiled and comparisons of fares, services, etc. to other major cities' cab companies is made.

Pittsburgh, "A Bridge of Sighs," July, 1985, pp. 11-12.

The transportation problems in a city that is dependent on bridges is the theme of this article.

Pittsburgh, "Second Avenue Blues," February, 1986.

This article features a comparison of 2nd Avenue in Pittsburgh 20 years ago and today. The focus is on economic changes that have come to Pittsburgh and how that is reflected in our driving habits.

Pittsburgh, "Pittsburgh Index," City Guide, SSB.

This is a guide to the city's Public Transportation.

Dilavore, Philip. "Why is it easier to ride a Bicycle than to Run the Same Distance?", The Physics Teacher, March, 1981, p. 194.

This article deals with friction and wasted motion and their effect on energy consumption.

Glass, Lynn W., "Do we still need Energy Education?", The Science Teacher, December, 1983, pp. 45-48.

This article gives a broad view of energy and its relation to societal needs. It also suggests an approach of teaching energy issues in the classroom.

Activity 1. Making Your Own Map

Objectives: Students will be able to demonstrate mapping skills by making a map depicting the route from their home to school.

Materials: Pencil, paper (colored pencils, markers - optional) (compass - optional)

Student Activity Sheets: SAS 1.1 Questions

Suggested Procedures:

1. The day before constructing the map, have students make observations on their way to and from school, noting street names, landmarks (for example, stores, cemeteries, churches, etc.), street lights, stop signs, speed signs, etc.

2. In class have students construct maps, including as many of the following as possible: (Teacher may develop symbols and legend with class).

   street names - indicate N, S, E, W, on map
   street lights
   stop signs
   speed limit and other traffic signs
   landmarks
   types of transportation observed along their route (for example bus, car, pedestrian)

3. When maps are completed, have students answer questions in SAS 1.1 relative to their constructed maps.

Optional Activity 1

Objectives: Students will walk for 20 minutes in area around their school, noting street names, speed, stop signs, street lights, landmarks, type of transportation along route, and identify compass directions N, S, E, W.

Students will construct a map of the area, using symbols to enter observed data as above. Teacher should develop symbols/legend with class.

III.

QUESTIONS

1. Compare your map with your neighbors. Would you be able to find his/her house using his/her map? Would he/she be able to find your house using your map?

2. How is your map the same as your neighbors? Different?

3. What method of transportation do you use following your route? Is it the same as your neighbor uses?

4. List at least 5 methods of transportation that can be used WITHIN the city of Pittsburgh.

   ____________________ ____________________

   ____________________ ____________________

   ____________________ ____________________

   ____________________ ____________________

   ____________________ ____________________

5. Does transportation determine when, how and in what mood you get to school?
   How?

III.

NAME:.. DATE:..........

MAP READING (A)

You and your family are going to Harrisburg Pa. to your cousins wedding. Your parents ask you to get a map of Pa. and find a way to get to Harrisburg. So here is the map go to it!!!!!!!!!!

DIRECTIONS:

1. SELECT THE BEST ROUTE THAT YOUR FAMILY CAN TAKE. WRITE THE ROUTES DOWN THAT YOU ARE GOING TO TAKE.

2. NAME TWO OR THREE CITIES YOU AND YOUR FAMILY MAY HAVE GONE THROUGH. (IF ANY)

3. THE ROUTE THAT YOU AND YOUR FAMILY TOOK HOW MANY MILES WERE THERE?
------------------------MILES/KILO-------------------

4. IF YOU TRAVEL AT THE AVERAGE SPEED OF 55 MILES AND ONLY TOOK TWO HALF HOUR STOPS. HOW LONG WOULD IT TAKE YOU AND YOUR FAMILY TO TRAVEL FROM PGH TO HARRISBURG.

   -------------------------------HOURS/MINUTES------------

5. IF YOUR FOLKS CAR GETS 20 MILES TO A GALLON AND GAS IS 85 CENTS PER GAL.
   A) HOW MANY GALLONS OF GAS WILL IT TAKE TO GO ROUND TRIP ....

   B) HOW MUCH WOULD IT COST FOR GAS TO GO ROUND TRIP?

   ....COST.

   C) WOULD $50.00 BE ENOUGH FOR YOUR TRIP?

   D) DID YOU HAVE FUN AT THE WEDDING?

Activity 2. Using a Standard City Map of Pittsburgh

Objectives: Students will be able to identify typical routes on the City of Pittsburgh Map.

Teacher Background: The purpose is for students to transpose their own route as they mapped it out on a standard city map. Students should find their section of the city and their high school on the city map, and trace a route from their home to their school. They will also enter symbols indicating various modes of transportation in their section of the city and in the city at large. This hands-on activity is used as a basis from which the lesson is extended to the concepts of how transportation technology affects people. The SAS worksheets are used in conjunction with the Pittsburgh map to further increase the students awareness of the role that transportation plays in daily life.

PITTSBURGH CITY MAP DIRECTIONS:

1. Map is in 6 numbered sections.
2. Assemble sections 1 to 6 and tape for complete city map. Trim edges.
3. Teacher can use sections needed for their students.
4. Map sections can be xeroxed.

Material: Maps of the City of Pittsburgh

Student Activity Sheets:

SAS 2.1 Using a Standard City Map of Pittsburgh

Suggested Procedures:

1. Distribute maps of the city. Students may work singly or in pairs, groups.
2. Distribute student directions and questions for using maps (see SAS 2.1).

III.

SAS 2.1

Using a Standard City Map of Pittsburgh

Student Directions:

1. Find your section of the City of Pittsburgh. What area of the city do you live in?

2. What section of the city is your school in?

3. Trace your route from home to school, using your self-constructed map.

4. How is your map the same as the city map? Different?

5. Which map do you find more useful to follow? Why

6. Are there alternate routes to your house from school (other ways of going)? Trace an alternate route. List the names of the streets (in order) on this alternate route.

7. What methods of transportation are available in your section of the city? Check the ones that apply:

   Car
   Bus
   Train
   Plane
   Incline
   Subway
   Other?

   Put symbols where these modes of transportation are found (example draw a bus or write B where a bus route is located; S for subway, etc.)

8. If you lived in Brookline, what is the most direct route to Point State Park in downtown Pittsburgh? Trace your route. List streets. What kind of transportation would you probably take?

9. If you lived in Spring Hill, what is the most direct route to Oakland? Trace your route. List streets. What kinds of transportation would you probably take?

Find these city high schools and give their coordinates.

Westinghouse (Homewood)
Oliver (North Side)
Carrick (South Side)

11. Many modes of transportation are available in the City of Pittsburgh. Mark by symbols (letter or drawings) where the following modes of transportation would be found in the city. Some are only found in certain areas; others you may mark in many places:

    bus
    car
    train
    subway
    incline
    boat
    seaplane (note that there is a seaplane base near Marshall Avenue--Northside)
    (boats for transporting other than people)
    bicycle
    walking (pedestrian)
    motorcycle
    Check each mode, as you mark it off on your map.

12. (Teacher transpose subway to their map). Trace the subway routes. (Use walking map)

13. Trace train route - mark T or symbol

14. Trace a bus route. (Can use bus schedules)
    (a) from home to school
    (b) from home to downtown Pittsburgh

15. Trace a car route:
    (a) from home to downtown Pittsburgh
    (b) from home to school

16. What are the map coordinates for:
    (a) Your home
    (b) Your school
    (c) The Pittsburgh Zoo
    (d) Frick Park
    (e) Three Rivers Stadium
    (f) Civic Arena
    (g) Monongohela Incline

Activity 3. Transportation to Urban Environments

Objectives: Students to evaluate the identified modes of transportation in terms of energy and environment.

Teacher Background: This activity is designed to look at issues of transportation and evaluate general attitudes.

Student Activity Sheets: 3.1 - 3.6 Transportation in Urban Environments.

Suggested Procedures: Distribute SAS 3.1 - 3.6. Students should complete sheets and discuss evaluations.

III.

SAS 3.1

TRANSPORTATION IN URBAN ENVIRONMENTS

A. Transportation is the act of carrying things or people (or both) from one place to another place. There are many transportation modes (methods or ways) available to us. Each mode of transportation has advantages and disadvantages. Completing the chart below will help you to reach some conclusions about the role of transportation in the urban environment. Briefly note your answers in the space provided.

Mode of Transport.	How often do you use this mode?			How do you feel about this mode?			How much does it cost to use?			What effects does it have on the environment?		Type of Fuel Used or Energy	Energy Conversion*
	Often	Sometimes	Never	Like	Don't like	No Opinion	Expens.	Moderate	Inexp.	Exhaust	No exhaust		
Airplane													
Car													
Truck													
Bus													
Bicycle													
Boat													
Walking													
Subway													
Incline													
Motorcycle													
Train													
Other													

*fuel is changed from chemical energy to what other form of energy.

III.

SAS 3.2

After you have completed the chart, use the information to help you evaluate transportation modes.

1. Which mode do you use most frequently? ____________________
Why?

Least frequently? ____________________________________
Why?

2. Which mode do you enjoy using the most? ____________________
Why?

The least? ____
Why?

3. Which mode has the highest costs to the user? _______________
Why?

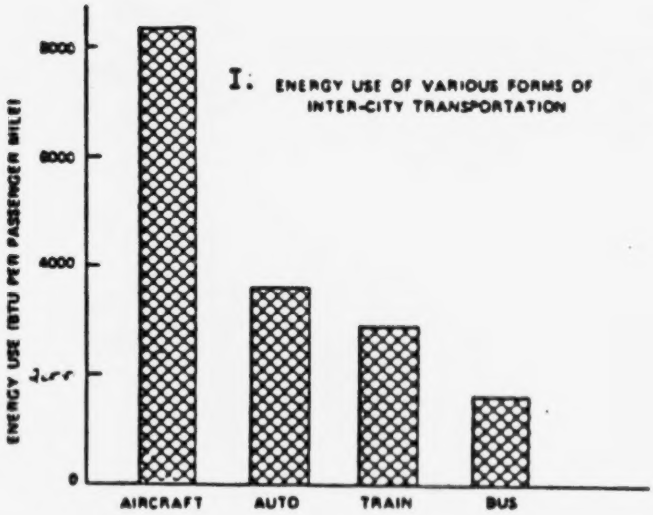
Which mode has the lowest costs?__________________________
Why?

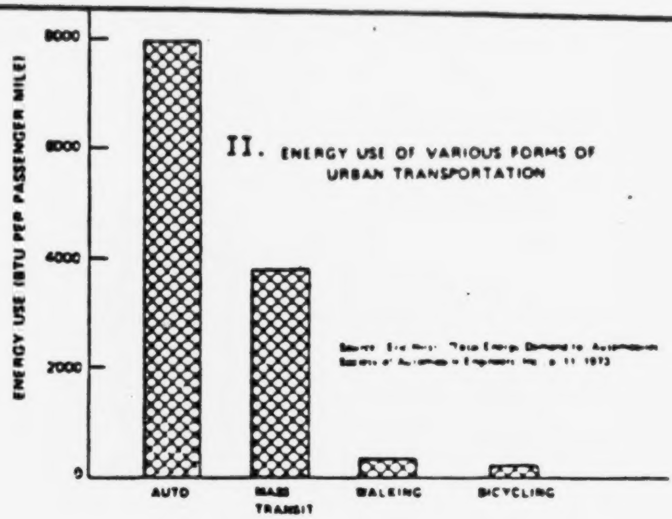
4. Which mode has the greatest effects on the environment? _______
What are some examples of these effects?

Which mode has the smallest effects on the environment? _______
Why is there little environmental impact?

5. What 2 forms of energy are used in all modes of transportation?

B. Before you come to any conclusions about "good" or "bad" modes of transportation, study the bar graphs below, and answer the questions that follow them. Each graph gives information on the energy use of four modes of transportation. Energy use is expressed in terms of "BTU per passenger mile." A BTU is a British Thermal Unit; it is a measure of heat. A BTU is the amount of heat needed to raise 1 lb. of water 1°F.





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III.

1. Graph I provides information about the energy use of four modes of inter-city transportation. What does "inter-city" mean?

   Graph II gives the energy use of four modes of urban transportation. What is "urban transporation"?

2. Which mode of inter-city transportation is the least efficient (uses the most energy for every passenger mile)?

   Which mode of inter-city transportation is the most efficient (uses the smallest amount of energy for every passenger mile)?

3. Which mode of urban transportation is least efficient?

   Which mode of transportation is the most efficient?

4. How might a mode of transportation that uses little energy be inefficient in other ways?

C. More on Energy Use and Transporation

1. Distinguishing Facts from Opinions. Using the information in the previous graphs, read the following statements and place an F in the space beside the facts (statements that can be verified or proved) and an O in the space beside the opinions (statements that some people believe or feel but that cannot be verified).

____ a. An aircraft uses more than 8000 BTU per passenger mile.

____ b. Walking is better for you than using mass transit.

____ c. Walking uses less energy than a bus.

____ d. The form of transportation that uses the least energy is bicycling.

____ e. In urban transportation, autos use twice as much energy as mass transit.

2. Using the graphs, list the Modes of transportaion that use:

Little Energy = 2000 BTU/ passenger mile or less.	Much Energy = 4000 BTU/ passenger mile or more.
1. ____________	1. ____________
2. ____________	2. ____________
3. ____________	3. ____________

3. Compare the efficiency of the automobile in Graph I and II. Which one is more efficient? How does that relate to gas mileage on highway vs city driving? Which kind of driving gets better gas mileage?

Activity 4. Getting There

Objectives: The student should be able to:

1. Compare different types of transportation in terms of their mileage and gas efficiency.
2. Determine by interpreting a graph, which form of transportation is the preferred choice for travel.

Materials: Graph paper, rulers

Student Activity Sheets:

SAS	4.1	Tables 1 and 2 - Getting There
SAS	4.2	Questions
SAS	4.3	One More Time

Suggested Procedures:

1. Graph, from the data in Table 1, in bar form, the type of transportation, on the horizontal axis and the fuel efficiency (miles/gallon) on the vertical axis.
2. Graph from Table 2, in bar form, the type of transportation on the horizontal against the people moving efficiency (P,PG) on the vertical axis.

Activity 4. Getting There

Table 1

Types of Urban Transportation	**Fuel Mileage (Average) (MPG = Miles Per Gallon)**
Automobile	18 MPG
Van	16 MPG
Bus	3.3 MPG
Pass Train	.1 MPG
DC Jet	.25 MPG

Table 2

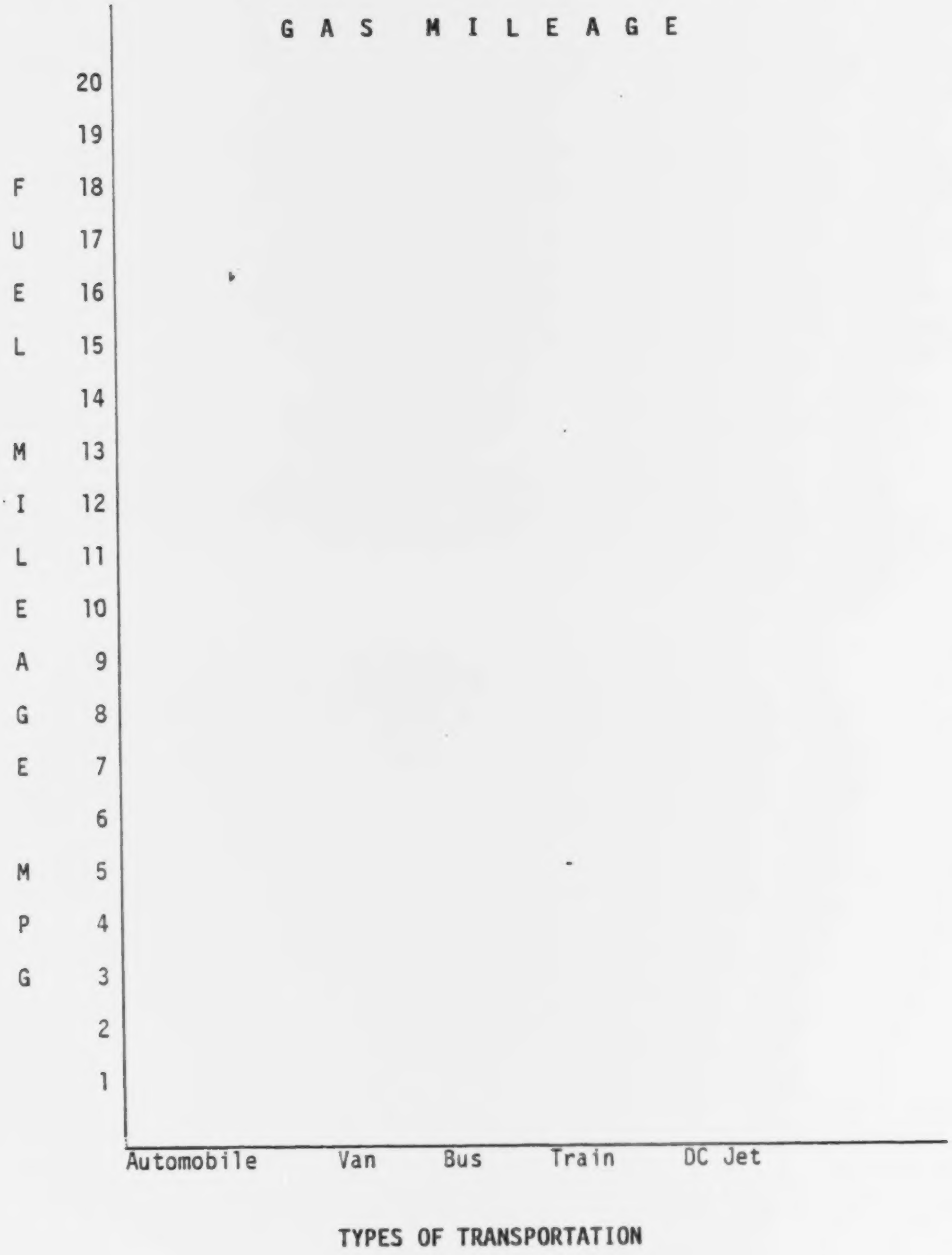
"Fuel Consumption Per Person"

Form of Transportation	**Number of People**	**MPG**	**Fuel Needed For 200 Mile Trip (in Gallons)**	**Gallons/Person (200 mile trip)**
CAR	1	18	11.1	11.1
CAR	2	18	11.2	5.6
CAR	4	18	11.6	2.9
VAN	1	16	12.5	12.5
VAN	2	16	12.6	6.3
VAN	4	16	12.8	3.2
VAN	8	16	13.2	1.65
BUS	5	3.3	60.0	12.0
BUS	20	3.3	62.0	3.1
BUS	40	3.3	64.0	1.6
TRAIN	1000	.1	2000	2.0
AIRPLANE	100	.25	800	8.0

Remember: Passenger miles per gallon is arrived by dividing the number of people into the amount of fuel used. Use bar graph to illustrate 200 mile trip/fuel/person.

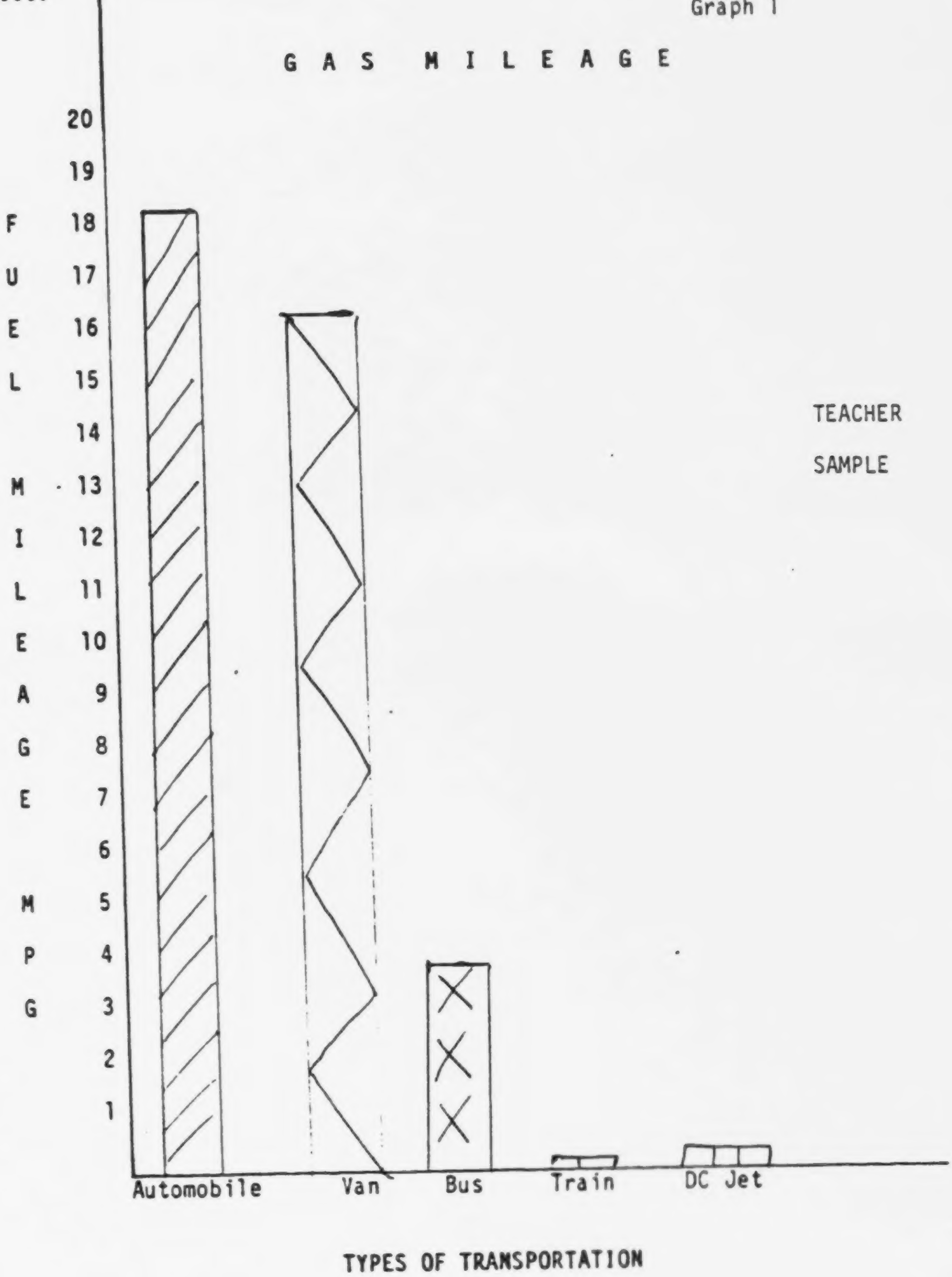
III.

SAS 4.1
Graph 1



III.

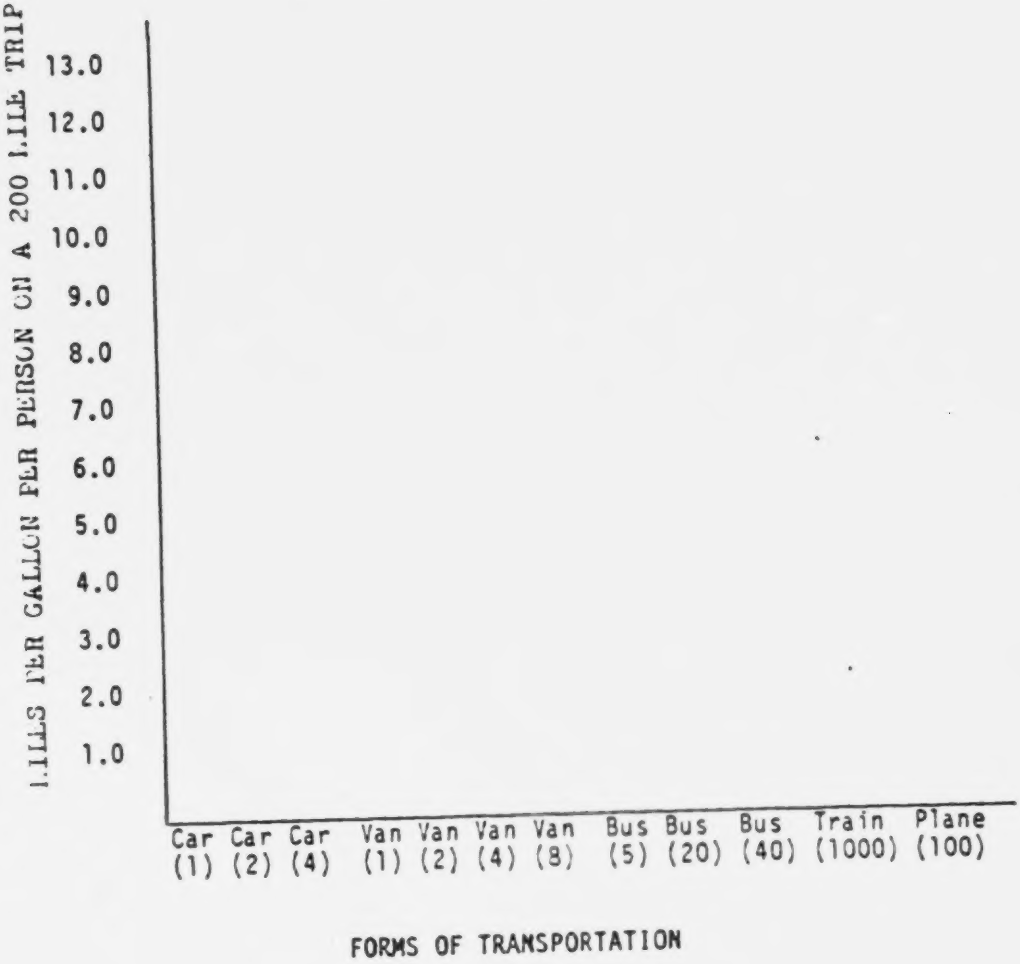
SAS 4.1
Graph 1



TEACHER

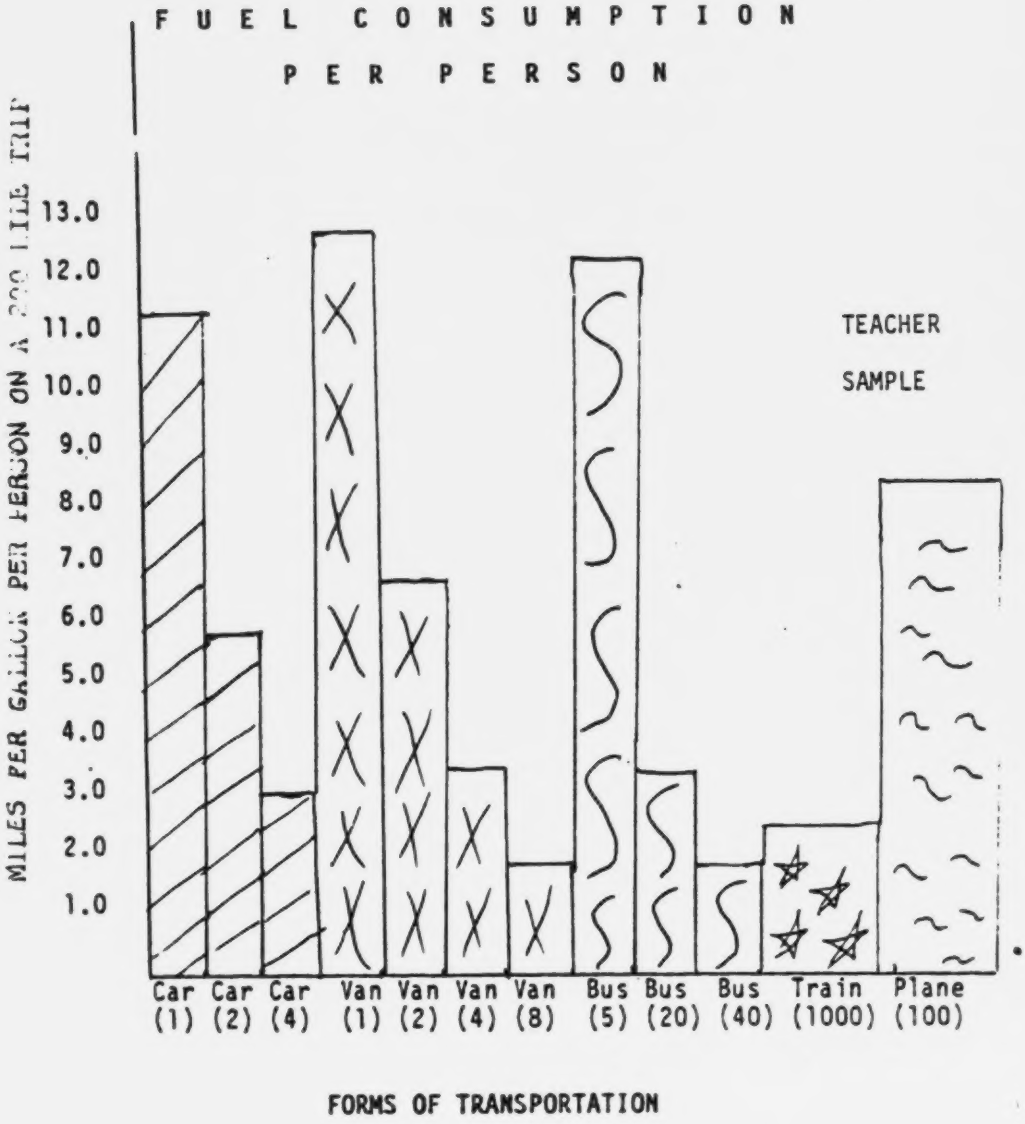
SAMPLE

FUEL CONSUMPTION
PER PERSON



III.

SAS 4.1
Graph 2



III.

Questions

1. Use Graph #1 to identify which type of transportation is the most efficient in miles/gallon? Why?

   The least efficient. Why?

2. Use Graph #2 to identify which type of transportation is most efficient in terms of fuel used per person. Why?

   The least efficient. Why?

3. Would putting twice the number of people in any of the listed vehicles make it more efficient per person? Explain your answer.

4. If 4 people are going on a 200 mile trip, would it be more fuel efficient per person to go in a van or a car?

5. Use Graph #2 to answer the following. Which is the **MORE** efficient means of transportation per person?

   (a) a bus with 20 or a car with 2
   (b) a van with 1 or a car with 1
   (c) a bus with 5 or a train with 1000
   (d) a bus with 20 or a train with 1000
   (e) a plane with 100 or a train with 1000
   (f) a bus with 40 or a train with 1000
   (g) a bus with 5 or a car with 4

6. Use Table 2 to compare the **TOTAL** gallons of gasoline that would be used by 40 people going on a 200 mile trip on the same bus with the **TOTAL** gallons of gasoline that would be used if those same 40 people each drove their own car 200 miles.

III.

7. In Table 2, the bus appears to be the most efficient in fuel per person. Are there disadvantagesa in using only buses for transportation? List as many as you càn.

8. One way to make a car more efficient is to have more people in the car. List as many advantages and disadvantages as you can for this idea.

9. Is there ever a time when a person might choose a less efficient form of transportation? Explain.

10. Why do you think some people chose to form car pools?

11. Do you think it is important for cars to be fuel efficient? Why or why not?

III.

ONE MORE TIME

1. Would you use the same amount of fuel for 1 person as for 4 people for a 200 mile trip? Explain your answer.

2. Name any factors or variables that would affect the amount of gas used in a 200 mile trip. Explain each of these factors clearly and as best you can.

3. Are mass transit systems, like buses or commuter trains, always more efficient than cars? Explain.

4. Suppose the mayor of your city appointed you as the new director of mass transit systems. He or she wants your ideas on the serious problem of too many cars in the city and the under used public transportation facilities. What would you say in a letter to the mayor?

Resource

Newton's second law of motion has a practical application in the design of automobiles. If you want a greater acceleration for your car, you can either install a more powerful engine (increase the force) or decrease the mass of the car. One reason why small cars get good gas mileage is their small mass. Everything else being equal, a 100 horsepower engine will accelerate a 1000 kg car up to 48 km/hr in half the time that the same engine could accelerate a 2000 kg car to the same speed.

(Physical Science, p. 233)
(General Science, pp. 19, 191-192)

Teacher Background: Optional Activity 4

Note: This activity uses the same basic data as Activity 4. And the concepts involved are the same. However, the approach varies: efficiency is determined by **people moving capacity** rather than miles **per person** per gallon.

OPTIONAL
Activity 4. Getting There

Table 1

Type of Vehicle	Fuel Effiency (MPG)	Average People/ Vehicle	People Moving (PMPG)
Automobile	18	2	36
Van	16	4	64
Bus	3.3	20	66
Passenger Train	.1	500	50
DC Jet	.25	100	25

Table 2

Type of Vehicle	No. of People	MPG	Fuel Needed for 20 mile trip (gallons)	People Moving Capacity (PMPG)
CAR	1	18	1.11	18
CAR	2	18	1.11	36
CAR	4	18	1.11	72
VAN	2	16	1.25	32
VAN	4	16	1.25	64
VAN	10	16	1.25	160
BUS	5	3.3	6.1	16.5
BUS	20	3.3	6.1	66
BUS	40	3.3	6.1	132
TRAIN	150	.1	200	15
TRAIN	500	.1	200	50
PLANE	75	.25	80	18.8
PLANE	100	.25	80	25

Note: People Moving Capacity can be calculated by multiplying number of people carried X fuel efficiency. For example (18 MPG) (2 passenger) = 36 PMPG.

III. Optional SAS 4.2

Activity 4.

Questions

1. Which type of transportation is the most efficiency in miles/gallon? The least efficient? (Use Graph 2).

2. Why do you think your choices for question one are true?

3. From graph number one, which type of transportation is most efficient in terms of people moving efficiency? Which was the least efficient?.

4. Would putting twice the number of people in the vehicle make it more efficient? Explain your answer (Refer to Table 2).

5. Is the data table or the graph easier to use to determine your answer? Why is you choice easier to use?

6. In Table 2, the bus and the van appear to be the most efficient in people moving. Are there disadvantages in using only buses or vans for transportation? List as many as can.

7. One way to make the car more efficient is to have more people in the car. List as many advantages and disadvantages as you can for this idea.

8. Sometimes you are willing to sacrifice efficiency for some other gain. What are some of the other gains and what vehicles do they apply to?

III. Optional SAS 4.2

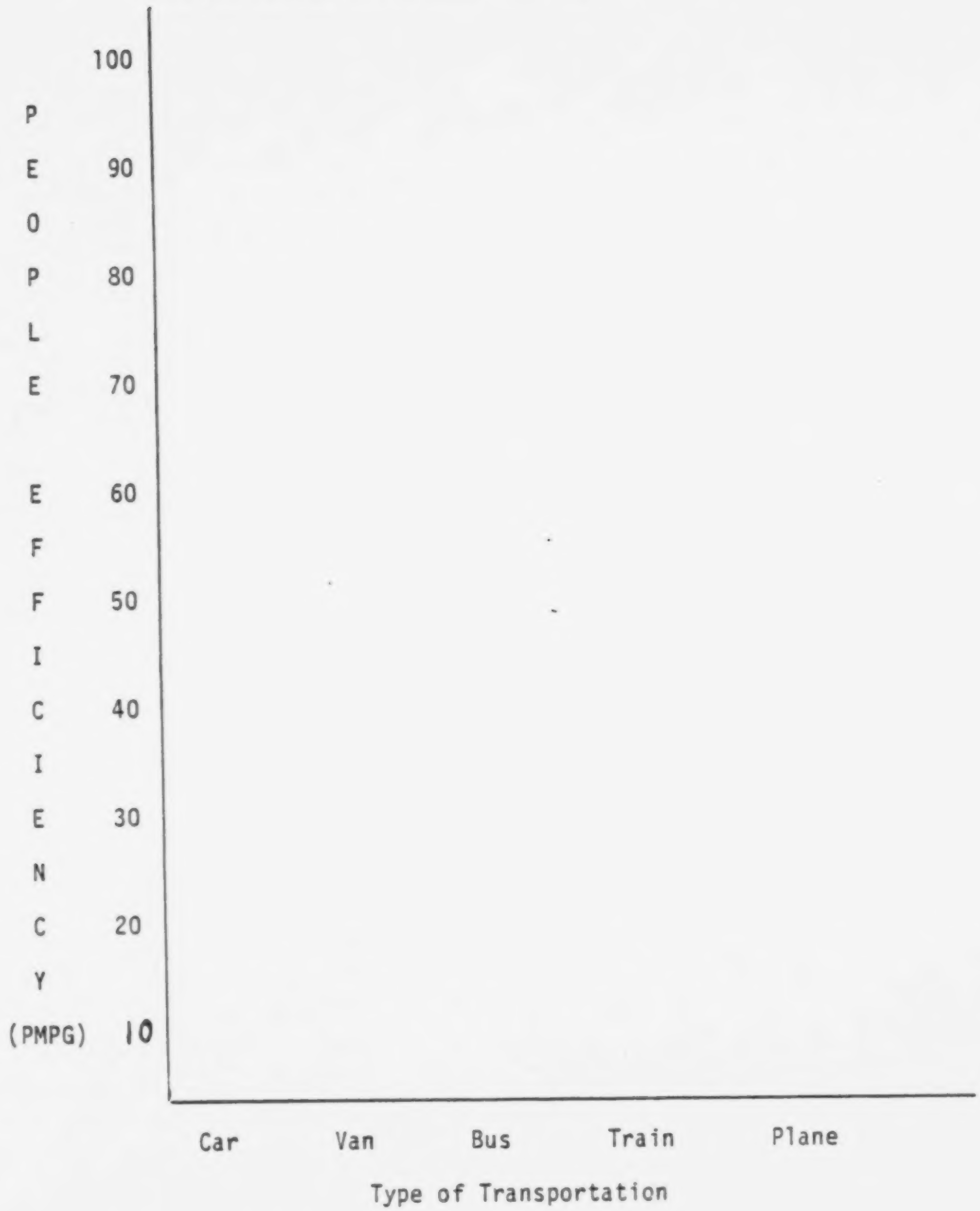
9. The PAT train has a capacity of 500 passengers. It usually carries only 125 passengers. Based on your knowledge of efficiencies why is PAT considering dropping this train. Can you apply this same thinking to other modes of transportation?

III.

Optional SAS 4.2
Graph 1

Activity 4.

People Moving Efficiency Vs. Type of Transportation

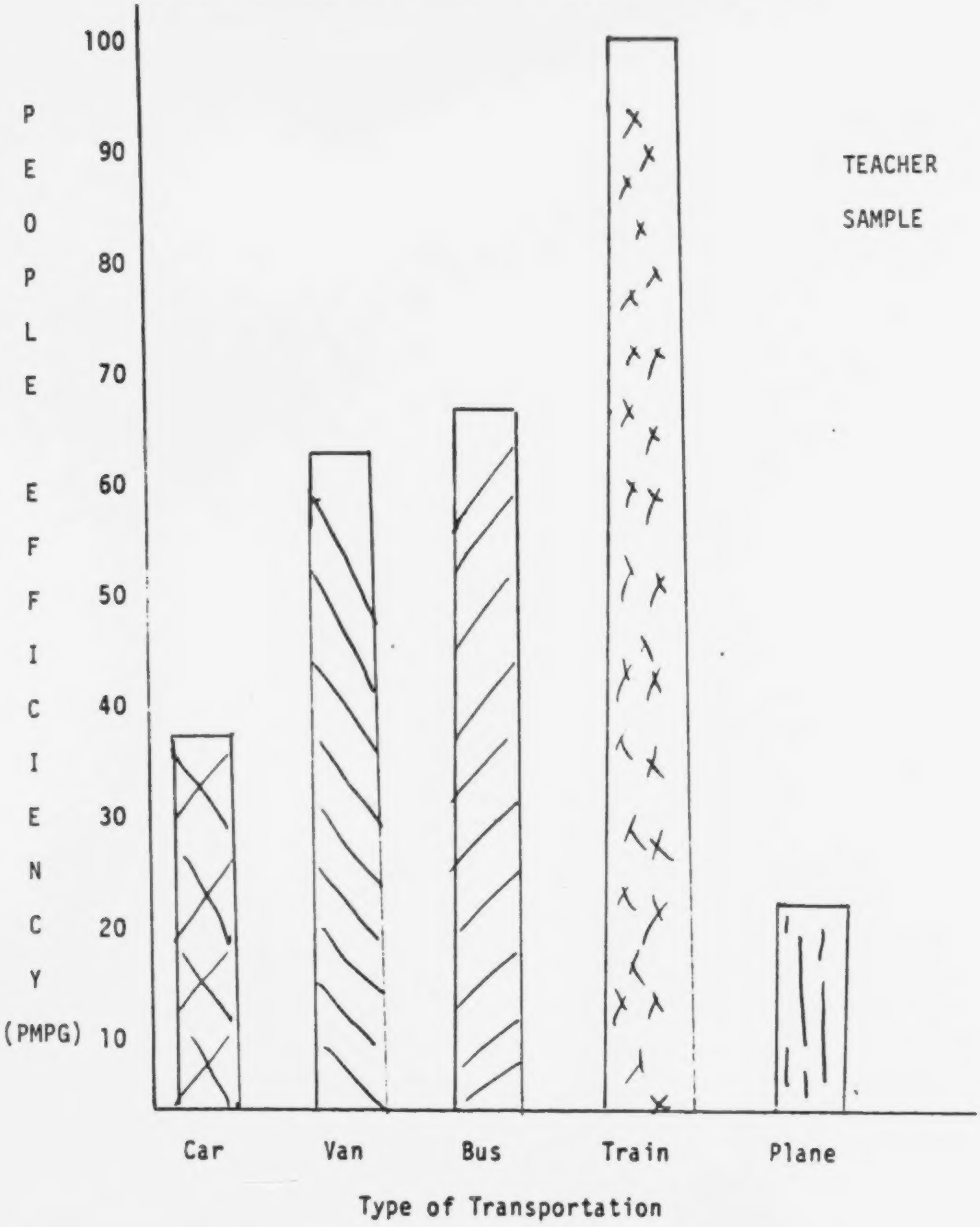


III.

Optional SAS 4.2
Graph 1

Activity 4.

People Moving Efficiency Vs. Type of Transportation

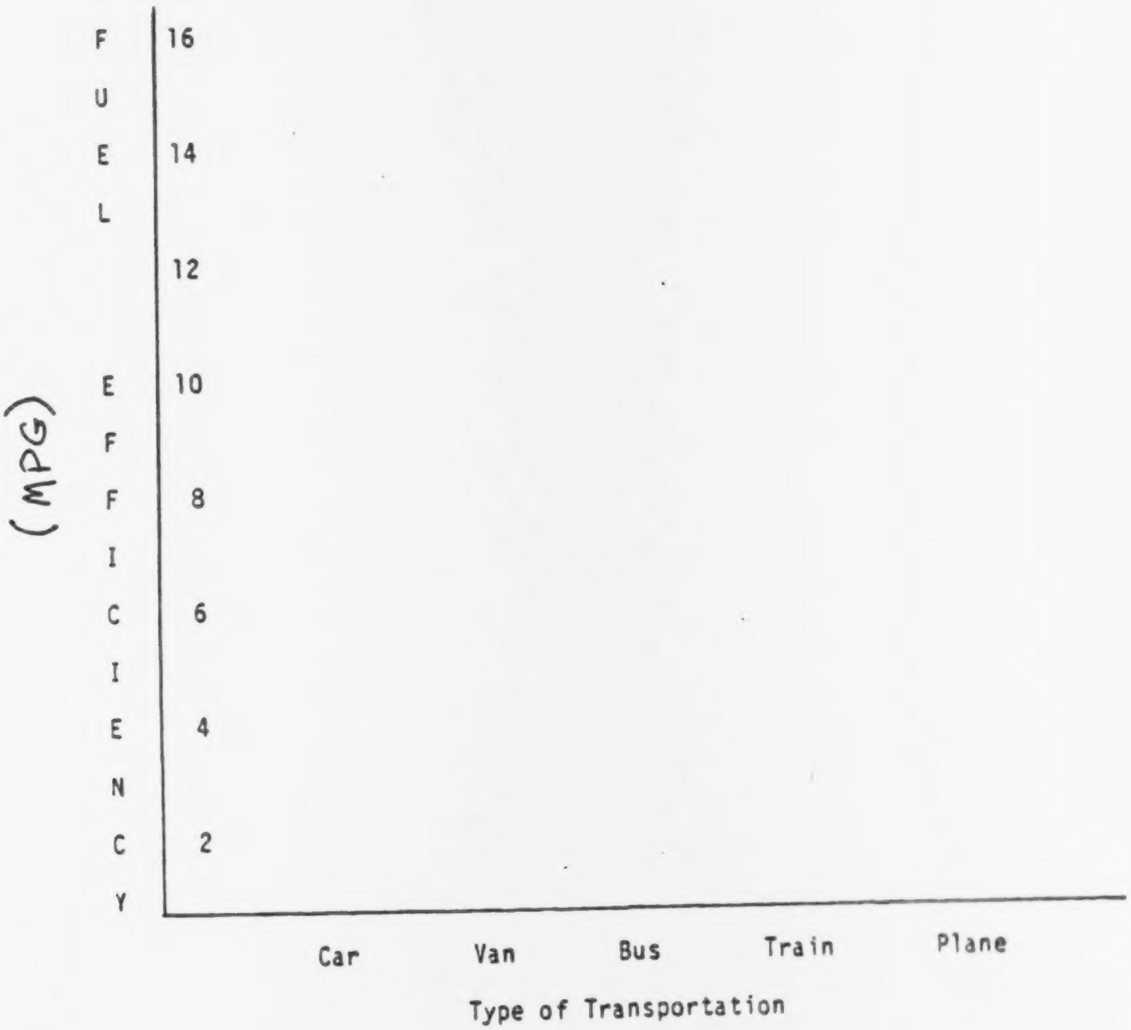


III,

Optional SAS 4.2
Graph 2

Activity 4.

Fuel Efficiency Vs. Type of Transportation

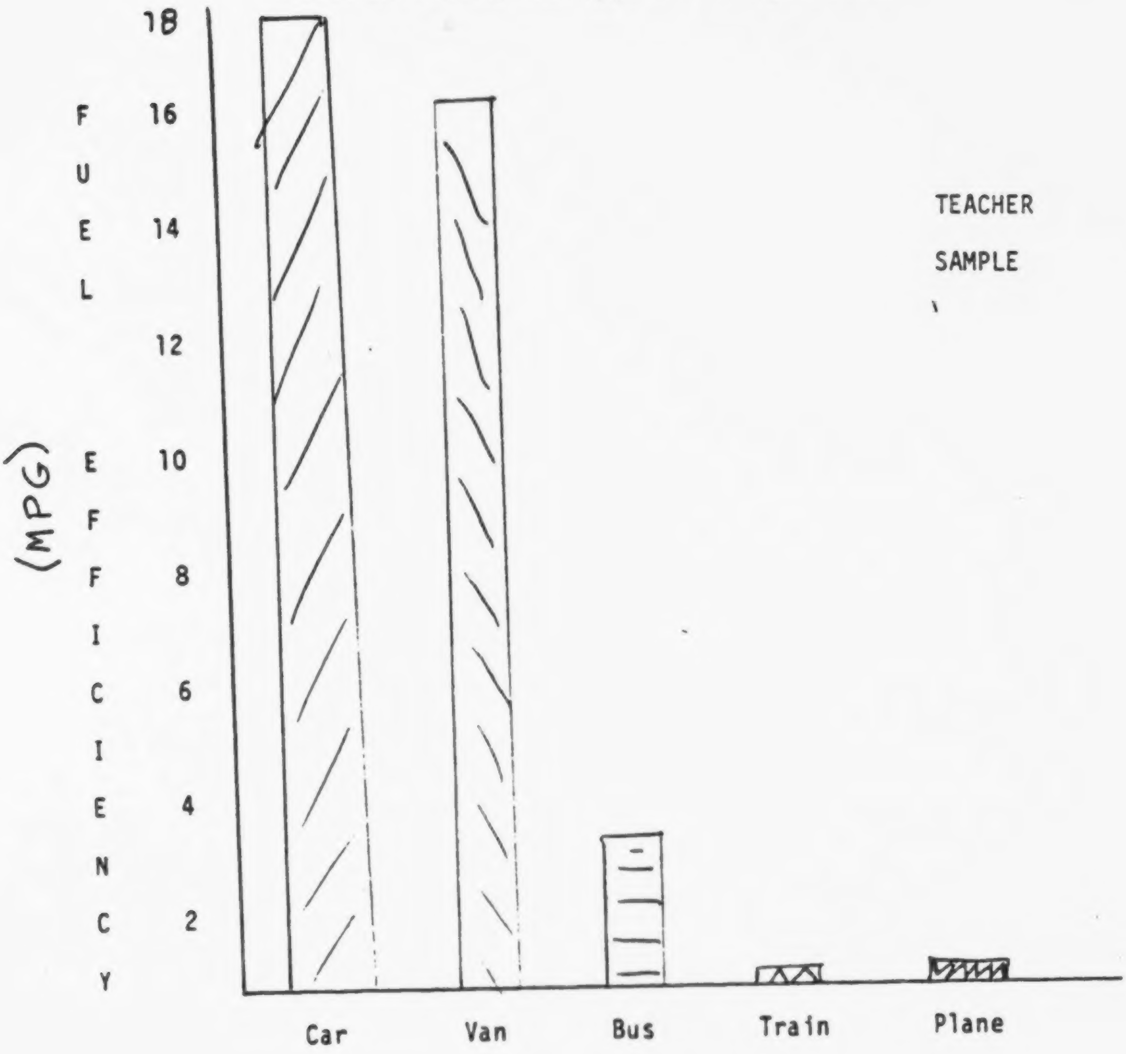


III.

Optional SAS 4.2
Graph 2

Activity 4.

Fuel Efficiency Vs. Type of Transportation



TEACHER

SAMPLE

Activity 5

Cars and Gas

Objectives: The student should be able to:

1. recognize the inverse relationship between the mass of a car and the distance traveled.
2. recognize the direct relationship between mass of car and fuel consumption.
3. recognize the direct relationship between fuel consumption and distance traveled.
4. recognize the direct relationship between force provided and distance traveled.
5. extrapolate and interpolate from a graph.

Teacher Background:

The purpose of these activities is to relate automobile gasoline consumption to the size of a car and the distance it is driven.

In doing the activities, students should be introduced to an inversely proportional relationship (mass vs. distance using a constant force in SAS 5.1) and a directly proportional relationship (force vs. distance using a constant mass in SAS 5.3). You may want to ask students which type of prediction would be more accurate - an interpolation or an extrapolation.

In using the car launch board, some hints may be useful. The acceleration pedal should be raised up off the board surface and the lower rubber band loop should be raised to the center of the supporting screw.

The teacher may want to point out that these activities are based on Newton's Second Law of Motion.

Materials:

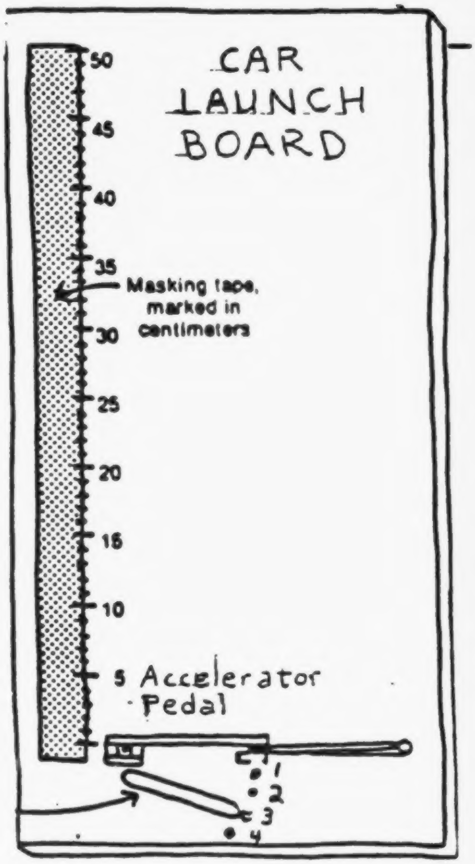
1. Car launch board with accelerator pedal.
2. Car
3. washers
4. masking tape
5. meter stick

Student Activity Sheets:

5.1 Activity! Constant Force
5.2 Questions
5.3 Activity! Constant Mass
5.4 Questions

Table 5.1

Constant Acceleration


CAR
LAUNCH
BOARD
50
45
40
35
30
25
20
15
10
5
Masking tape, marked in centimeters
Accelerator Pedal
1
2
3
4

Distance Traveled in CM

Trials

Number of Washers	1	2	3	Avg.
0 washer				
1 washer				
2 washers				
3 washers				
4 washers				

Procedure:

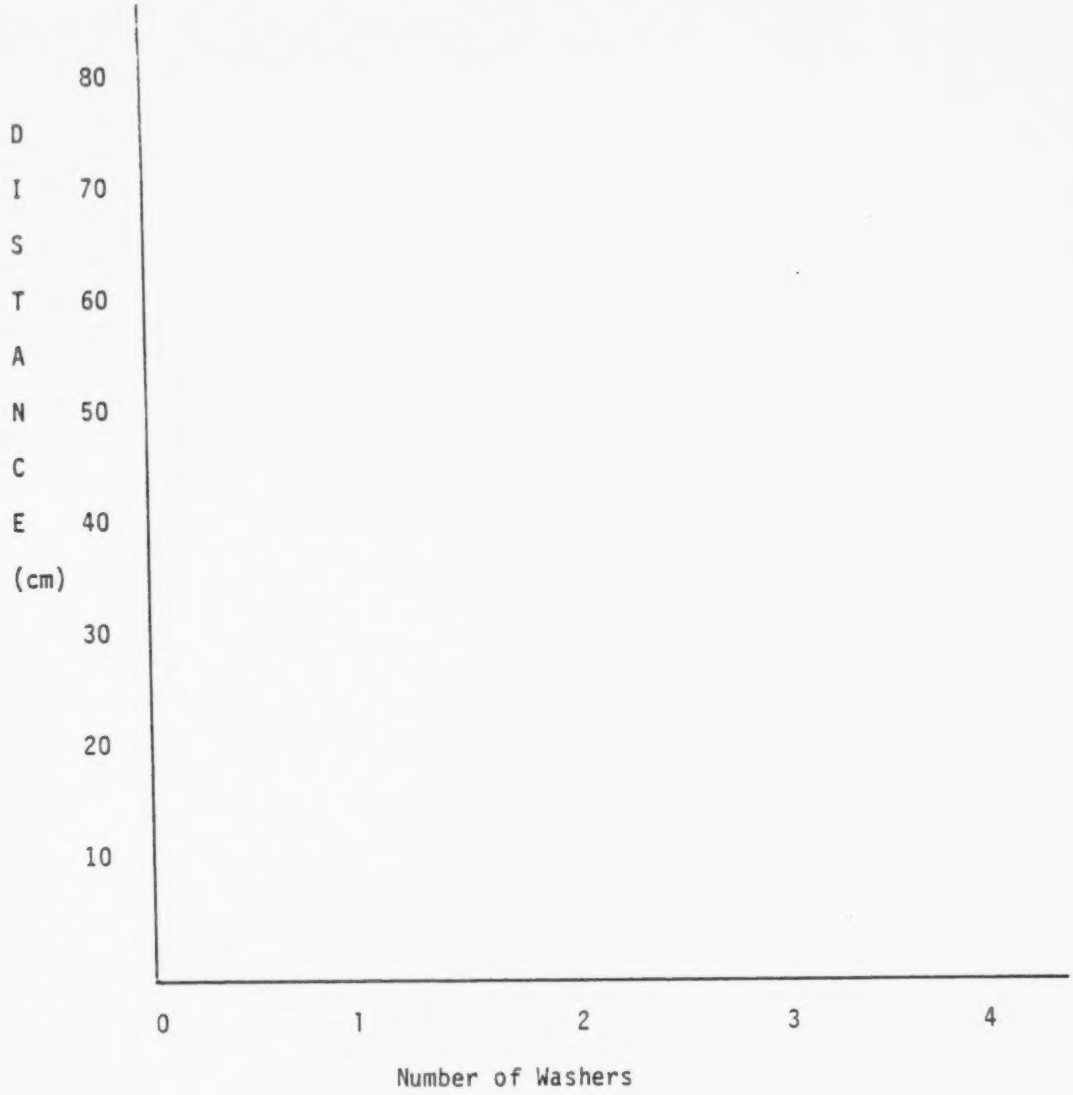
1. Place masking tape along edge of board, staring at 0 cm.
2. Measure off and mark tape in 5 cm increments as in picture.
3. Launch the toy car without washers.
4. Measure and record the distance traveled in centimeters.
5. Run 3 trials from launch point 1.
6. Repeat steps 3-5, using 1,2,3, and 4 washers.
7. Average the readings from each trial run.
8. Graph results, placing distance traveled on the vertical axis versus the number of washers on the horizontal axis.

III.

SAS 5.1
Graph 1

Constant Force

Different Mass

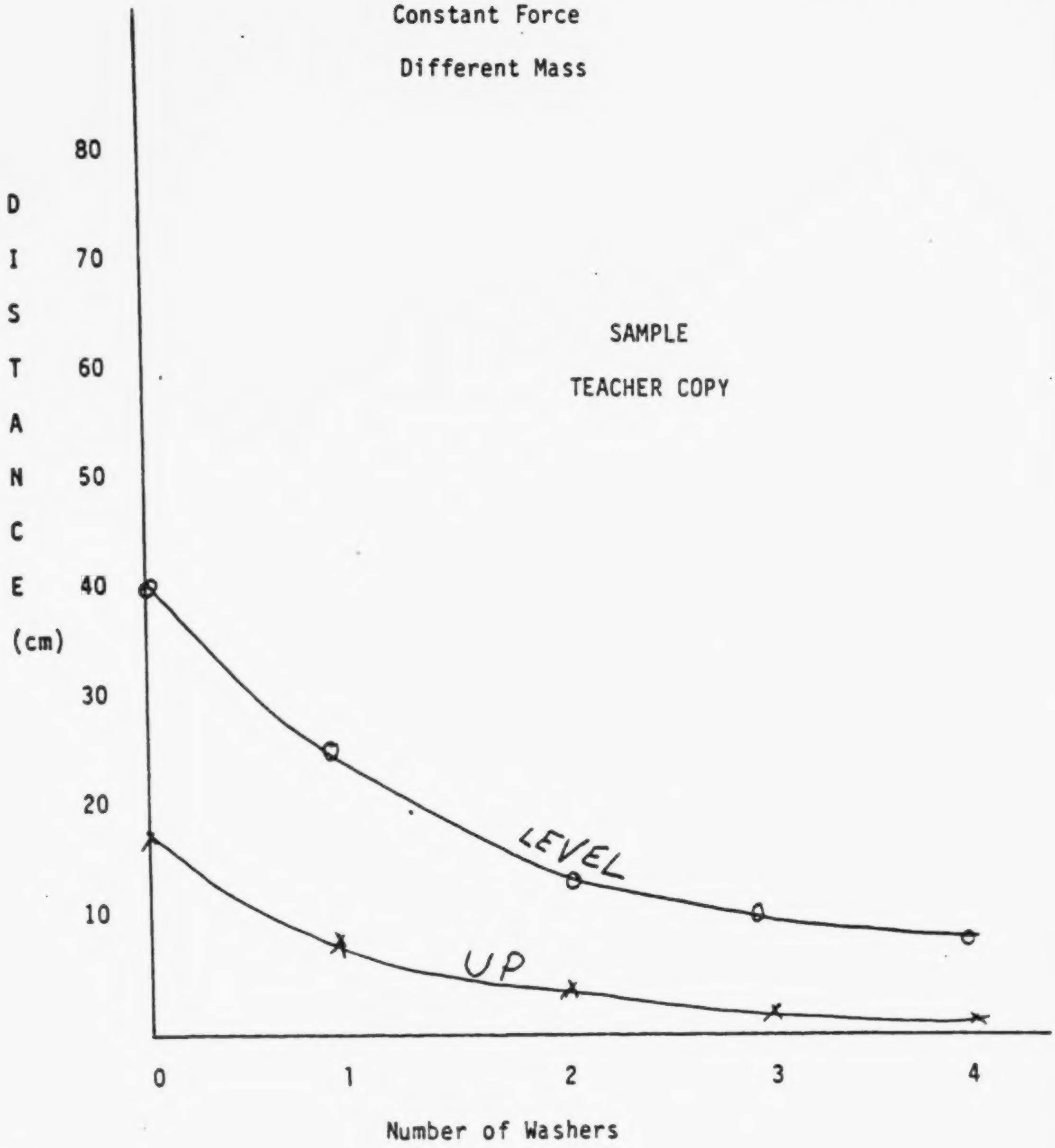


III.

SAS 5.1
Graph 1

Constant Force

Different Mass



SAMPLE

TEACHER COPY

III.

QUESTIONS

1. Which car went the greatest distance?

2. Which car went the least distance?

3. What is the relationship between the mass of the car and distance traveled?

4. Would a heavy car use the same amount of gas as a light car to go the same distance? Explain.

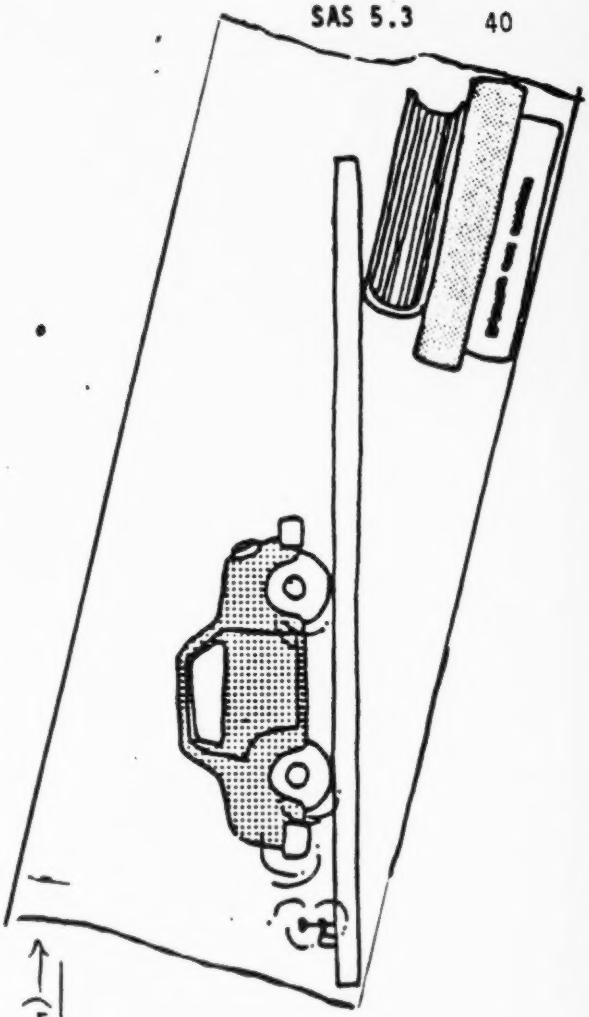
5. Will the energy in one gallon of gasoline move a heavy car the same distance as a light car? Explain.

6. Use your graph to predict how far a car would go if it had 2½ washers? If it had 5 washers?

Table 5.3

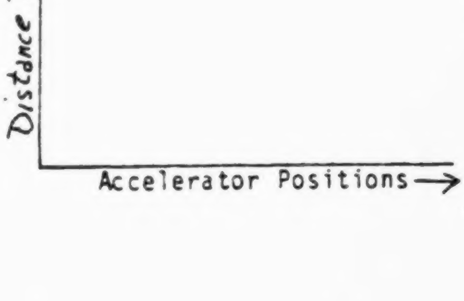
Constant Mass

	Distance Traveled in CM			
	TRIALS			
Accelerator Positions	1	2	3	Avg.
1				
2				
3				
4				



Procedure:

1. Place 3 washers (constant mass) on car.
2. Launch car 3 times from each of the four peg positions.
3. Measure and record distance traveled in centimeters.
4. Average the readings for each trial run.
5. Graph results, placing distance traveled on the vertical axis versus the number the accelerator positions on the horizontal axis.



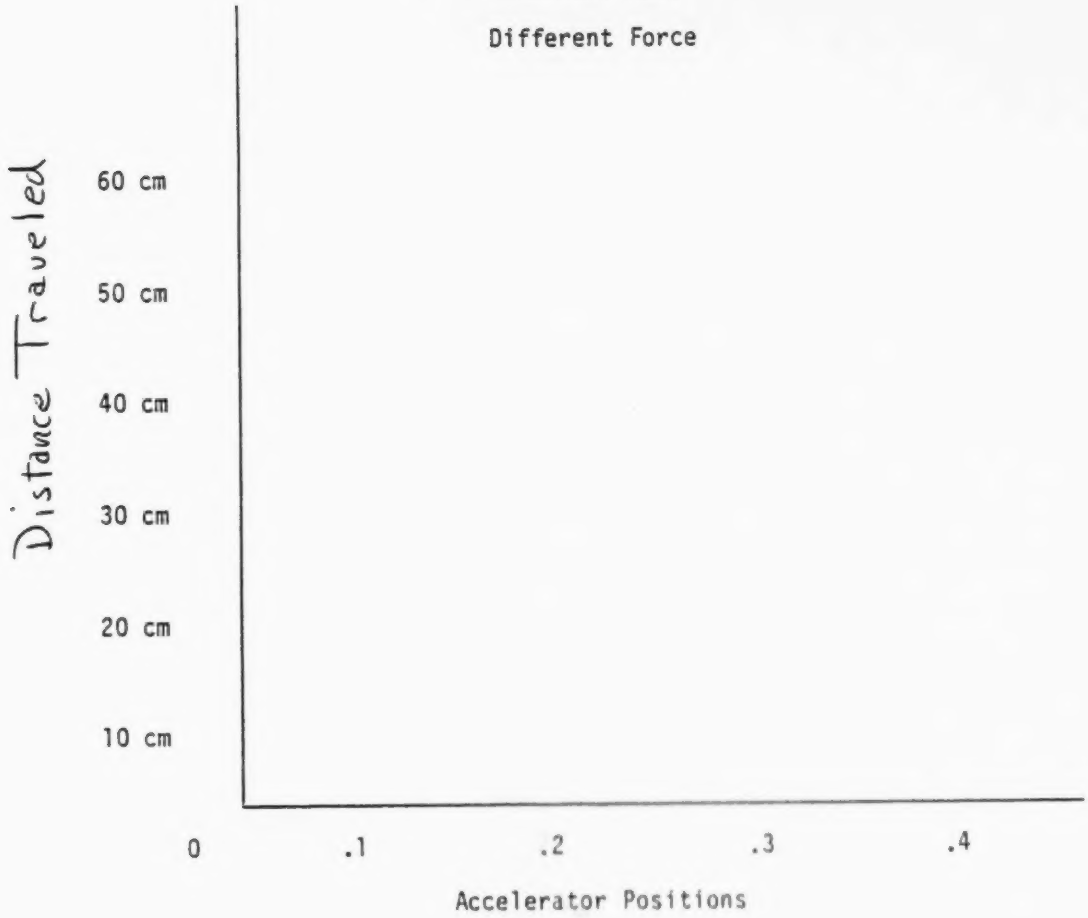
III.

SAS 5.3
Graph 1

Graph

Constant Mass

Different Force



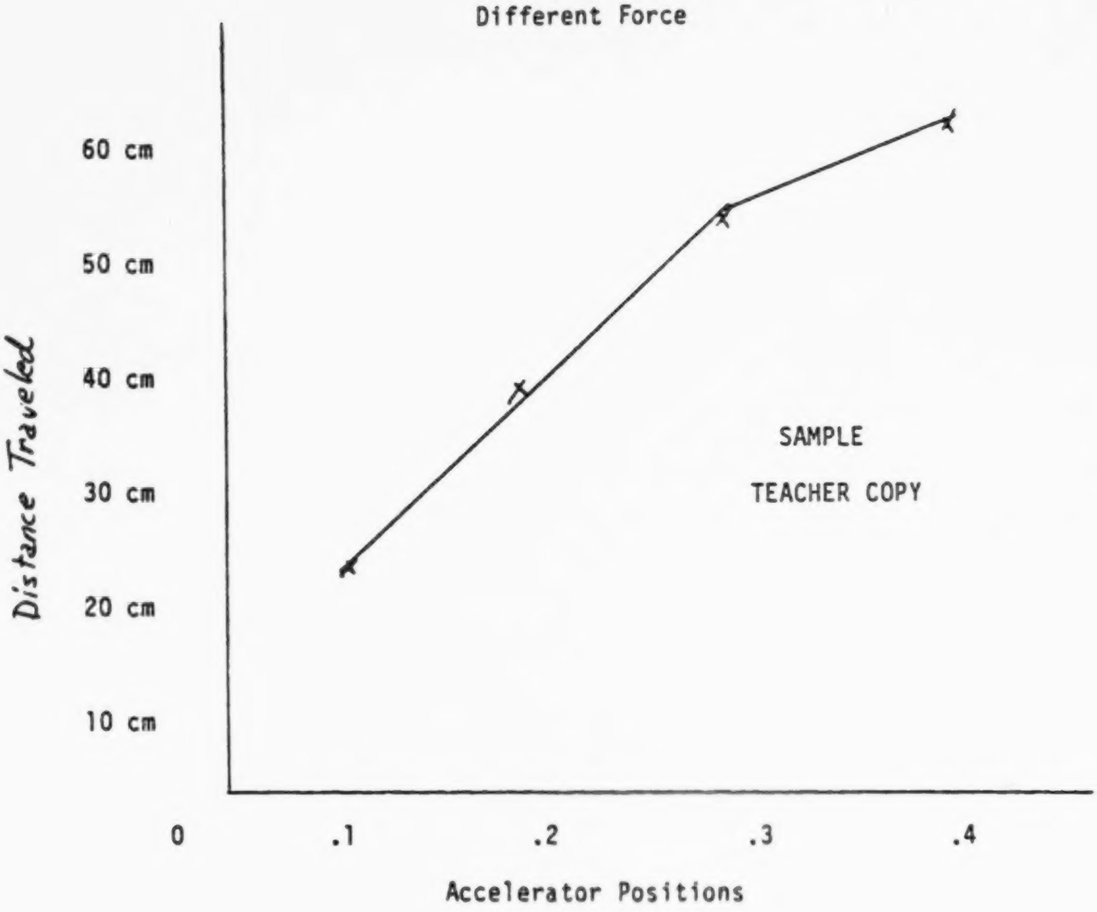
III.

SAS 5.3
Graph 1

Graph

Constant Mass

Different Force



III.

QUESTIONS

1. Which accelerator position caused the car to go the greatest distance?

2. Which accelerator position caused the car to go the least distance?

3. Which accelerator position provides the greatest force? The least force?

4. What is the relationship between force and distance traveled?

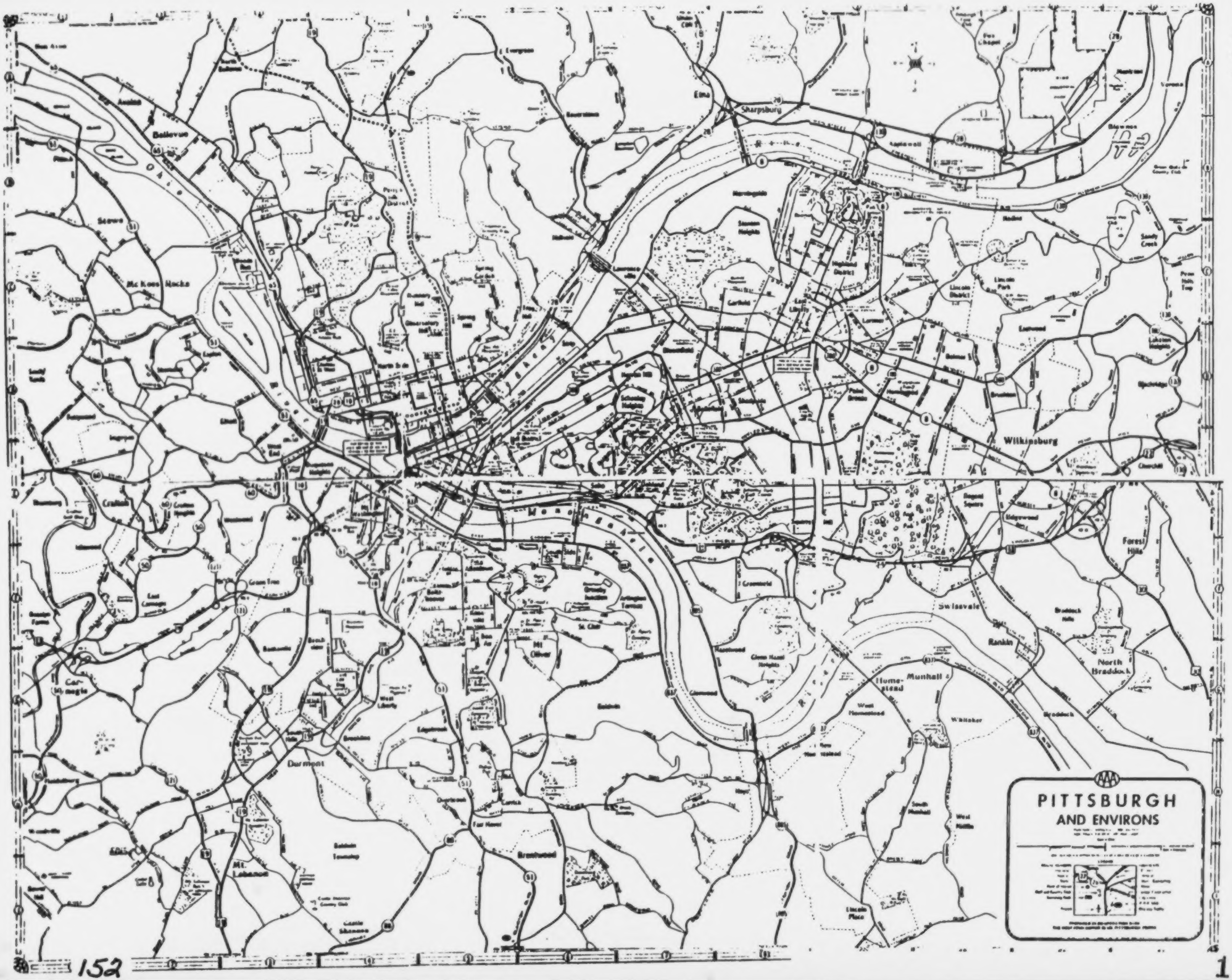
5. To provide a greater force in acceleration, would more or less energy (gasoline) be required? Explain.

6. What is the advantage of using the shortest route to a given location?

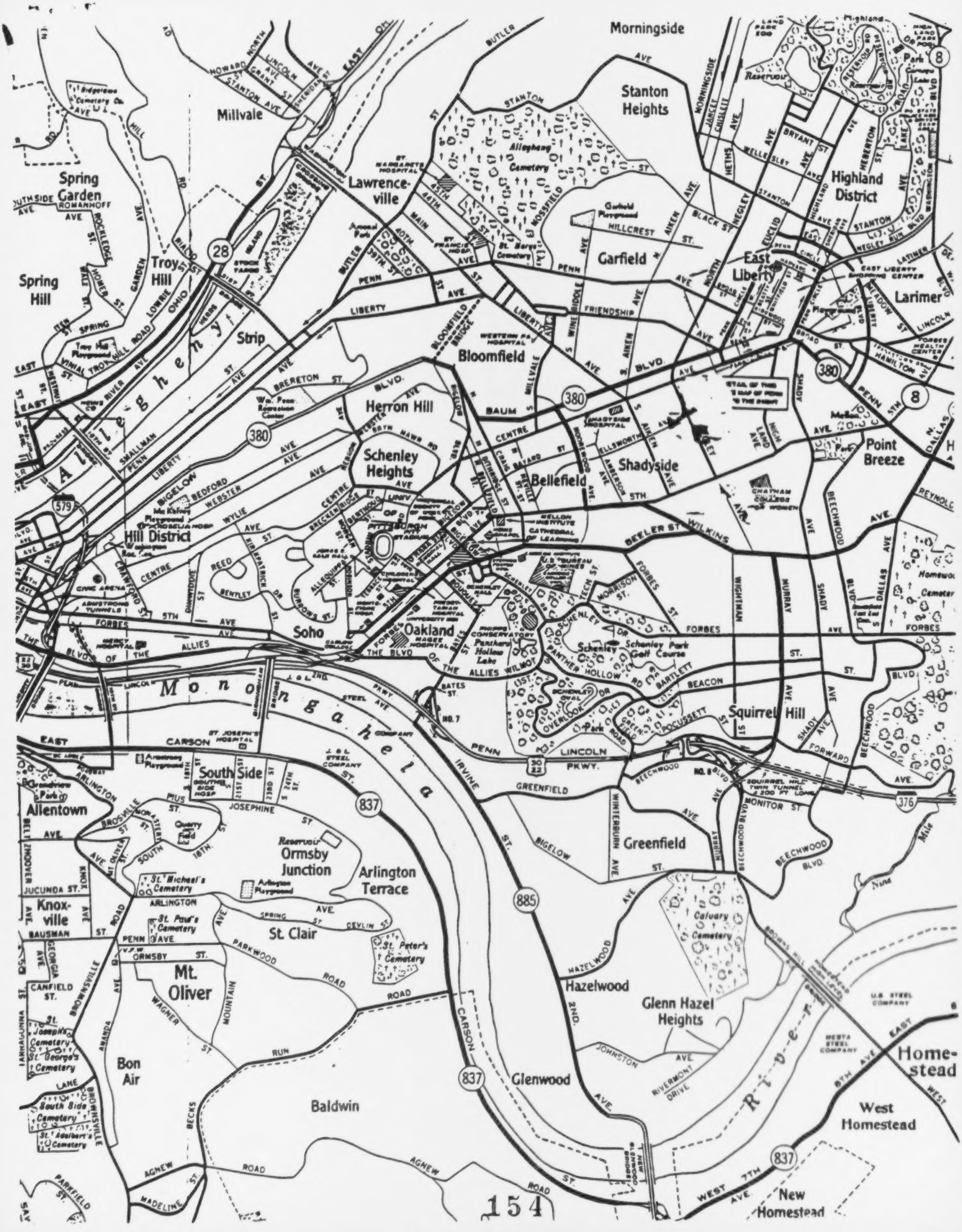
7. Use your graph to predict the distance a car would travel if the accelerator were released half-way between positions 1 and 2: if the accelerator were released from a fifth accelerator position?

QUESTION FOR OPTIONAL PROCEDURE

1. How does climbing Pittsburgh's hills affect the amount of gas you use as opposed to driving the same distance on Utah's salt flats?


Ben Avon
Avalon
Bellevue
Ohio
Sharpsburg
Etna
Aspinwall
Blawnox
Stowe
McKees Rocks
Millvale
Lawrenceville
Morningside
Highland District
East Liberty
Lincoln District
Bloomfield
Shadyside
Oakland
Point Breeze
Homewood
Wilkinsburg
Churchill
Sandy Creek
Penn Hills Twp
Regent Square
Edgewood
Forest Hills
Monongahela
Swissvale
Rankin
North Braddock
Braddock
Homestead
Munhall
West Homestead
Whitaker
Hazelwood
Glen Hazel Heights
St. Clair
Arlington
Mt. Oliver
Crafton
Green Tree
Carnegie
Beechview
Brookline
West Liberty
Dormont
Mt. Lebanon
Overbrook
Carrick
Brentwood
Baldwin Township
Castle Shannon
South Homestead
West Mifflin
Lincoln Place

PITTSBURGH
AND ENVIRONS


Morningside
Stanton Heights
Highland District
Millvale
Spring Garden
Lawrenceville
Allegheny Cemetery
Troy Hill
Spring Hill
Garfield
East Liberty
Larimer
Strip
Bloomfield
Herron Hill
Schenley Heights
Point Breeze
Shadyside
Bellefield
Hill District
Civic Arena
Soho
Oakland
Schenley Park
Schenley Park Golf Course
Panther Hollow Lake
Squirrel Hill
Allegheny
Monongahela
River
South Side
Allentown
Ormsby Junction
Arlington Terrace
Knoxville
St. Clair
Mt. Oliver
Greenfield
Calvary Cemetery
Hazelwood
Glenn Hazel Heights
Homestead
West Homestead
New Homestead
Bon Air
Baldwin
Glenwood
Homewood Cemetery
St. Michael's Cemetery
St. Paul's Cemetery
St. Peter's Cemetery
St. Joseph's Cemetery
St. George's Cemetery
South Side Cemetery
St. Adalbert's Cemetery
Reservoir
28
380
579
8
837
885
30
22
376
Penn Lincoln Pkwy.
Squirrel Hill Twin Tunnel
Forbes Ave
Fifth Ave
Penn Ave
Liberty Ave
Baum Blvd.
Carson St.
Boulevard of the Allies
Beechwood Blvd.
Murray Ave
Shady Ave
Brownsville Road
Arlington Ave
Greenfield Ave
Irvine St.
Hazelwood Ave
Second Ave.
Browns Hill Road
U.S. Steel Company
Mesta Steel Company

PITTSBURGH STS PROJECT

TEACHER EVALUATION FORM

Name ______________________________

School ______________________________

Grade Level ______________________________

Module: Intro A 1 2 3 4
(circle one)

Activity Title & Number ______
____

Please ANSWER EACH OF THE FOLLOWING QUESTIONS AT THE COMPLETION OF EACH ACTIVITY. Please comment in more detail on separate pages of paper where appropriate. Circle the most appropriate response.

1. OBJECTIVES

Were the stated objectives clear and accurate?	Excellent	Good	Poor

2. TEACHER BACKGROUND

Was the teacher background accurate?	Excellent	Good	Poor
Was the information provided a sufficient background on the subject?	Excellent	Good	Poor

3. MATERIALS

Was the materials list complete?	Excellent	Good	Poor
Did you have enough of each material required?	Excellent	Good	Poor

*Please indicate any resources, books (teacher or student), equipment, etc. that your recommend for inclusion in future modules.

4. STUDENT ACTIVITY SHEETS

Were the Student Activity Sheets (SAS):

Relevant to the objectives?	Excellent	Good	Poor
Clear and logical?	Excellent	Good	Poor

*Which were the most successful activities?

5. EXTENDED ACTIVITIES

*Have newly acquired decision making skills lead to action on personal problems? Involvement in community organizations? Involvement in local government issues? Other?

6. **EVALUATION**

What method of student evaluation did you use? (SAS sheet, separate test, etc.?)

*How successful were the students?

7. **PROCEDURE**

Was the suggested procedure clear and complete? Excellent Good Poor

*Did you follow the suggested procedure? What modifications, if any, did you make?

8. RATE THE FOLLOWING: (circle one)

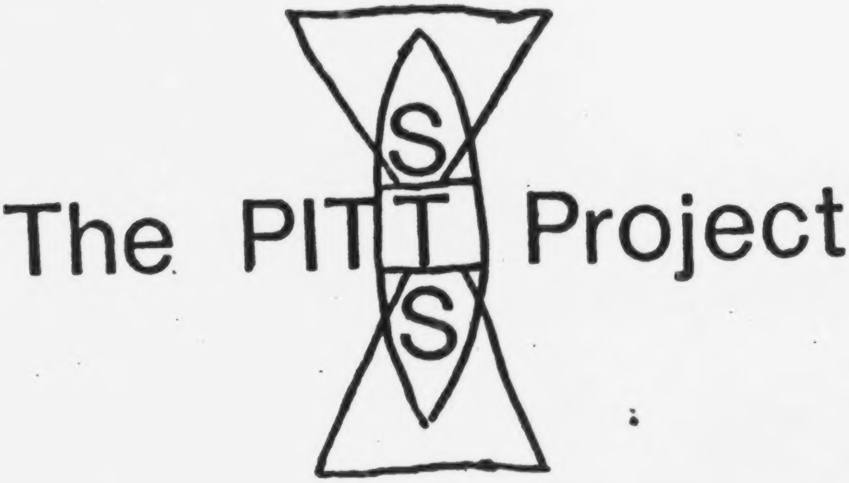
Student interest	High	Medium	Low
Appropriateness of material for students	High	Medium	Low

9. Do you recommend this activity for future use?

10. Other comments/recommendations:

Teacher signature ______________________ Date ________

Date when Activity was completed ______________________


The PIT T Project
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MODULE IV

THE PITTSBURGH SCIENCE TECHNOLOGY SOCIETY PROJECT

AUTO ISSUES: THE SPEED LIMIT, SEAT BELTS, AND YOU

THE PITTSBURGH SCIENCE TECHNOLOGY SOCIETY PROJECT

MODULE IV

AUTO ISSUES: THE SPEED LIMIT, SEAT BELTS, AND YOU

developed by

James Metzger, Sharon Lace, Steve Schwab,
John Sparvero, David Vause, George O'Brien, and Will Korth
with the Inservice Workshop Participants

June, 1988

George O'Brien, Project Director and Series Editor
University of Pittsburgh

THE PITTSBURGH SCIENCE TECHNOLOGY SOCIETY PROJECT

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Module IV

Auto Issues: The Speed Limit, Seat Belts, and You

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TEACHER EVALUATION FORM -

MODULE IV

Auto Issues: The Speed Limit, Seat Belts and You

COMPETENCIES

A. Processes

1. Observing
2. Classifying
3. Inferring
4. Predicting
5. Measuring
6. Communicating
7. Using Space/Time Relations
9. Formulating Hypotheses
10. Experimenting
11. Recognizing Variables
12. Interpreting Data

ACTIVITIES

1. The Speed Limit
2. The National Speed Limit
3. Fuel Consumption and the Speed Limit
4. Do Seat Belts and Other Safety Devices Prevent Injury and Death?

INSTRUCTIONAL OBJECTIVES

At the end of these lessons, each student should be able to:

1. Determine why various speed limits are posted in their neighborhood.
2. Determine how effective speed limits really are.
3. Illustrate why the nation has established a national speed limit.
4. Gather and analyze data concerning speed limits and variables.
5. Construct and interpret a graph.
6. Identify the major factors affecting fuel consumption at different speeds.

7. Evaluate positive and negative aspects of the 55 MPH speed limit.

8. Make decisions concerning the effectiveness of seat belts and other safety devices in cars.

9. Analyze data concerning accidental deaths.

ACTIVITY 1. Speed Limit

Objectives: The student should be able to:

1. investigate why various speed limits are posted in our neighborhood.
2. determine how effective the speed limits really are.

Teacher Background Information Students should be allowed to make observations of signs & landmarks while also completing activities that investigate local speed limits and parking availability.

After these activities are completed, assign students to categorize the observations they made for dicussion tomorrow which can be quantitative or qualitative in nature.

Suggested Categories:

Living   Not Living

Directional Signs   Safety Signs   Informational Signs

Student Activity Sheets: SAS 1.1 Questions

Materials: pen, paper

Optional Activities:

1. Go to the local police station to gather data on frequency of accidents in the school neighborhood.
2. Compare speed limits in the area to speed limits of other areas (suburb, country, parks, etc.).
3. Survey 25 adults on whether they really obey the speed limit.
4. Draw a map of the route you traveled include scale and direction.
5. Calculate how much money you would spend parking at a meter for 4 hours; 8 hours (cost $0.25 per hour).

Suggested Procedures: Walk through the neighborhood surrounding your school, record the street name and the speed limit posted on that street. Record your observations of each street you travel. Construct a table like the following.

Street	Speed Limit	Observations of Street
Cane Ave.	25	Traffic light, no parking signs, two lanes, cobblestone

IV. QUESTIONS

After analyzing the data table, answer the following:

1) Are there different speed limits in the area?

2) What conditions determine a slower or faster speed limit?

3) What would be good speed limits for the following areas?

School _____ Park _____ Alley _____ Hospital _____

City Street _____ Parkway _____ Turnpike _____ Suburb _____

Mall Parking Lot _____

4) Do drivers you know obey the speed limit? Does the speed limit keep people from going too fast?

ACTIVITY 2: The National Speed Limit

Objectives: The student should be able to:

1. investigate and illustrate why the nation has established a national speed limit.
2. gather and analyze data.
3. construct and interpret a graph.

Materials: pencil, paper

Student Activity Sheets:

SAS 2.1 Motor Vehicle Traffic Deaths by States 1972-73
SAS 2.2 Motor Vehicle Traffic Deaths by States 1982-83
SAS 2.3 State Automobile Speed Limits 1973
SAS 2.4 Population of the States (1980)
SAS 2.5 Questions
SAS 2.6 Map of the United States

Suggested Procedures: Using the information above, construct a data table as follows:

State	Speed Limit before 1974	Population	Region	Deaths before/after
PA	65	11.5 million	Middle Atlantic	2225/1750

Color your chosen states on the map with the color that matches the speed limit on the following chart

65 MPH	green
70 MPH	yellow
75 MPH	blue
80 MPH or above	red

After constructing the table answer and discuss the student questions.

TABLE 4.1
MOTOR VEHICLE TRAFFIC DEATHS BY STATES (1972 - 73)

Source: State traffic authorities

Place of Accidents	Number 1973	Number 1972	Mil. death rate* 1973	Mil. death rate* 1972
Total U.S.*	55,800	56,600	4.3	4.5
Alabama	1,235	1,248	6.2	6.0
Alaska	76	59	4.7	3.9
Arizona	958	807	5.9	5.5
Arkansas	672	764	5.0	6.0
California	4,905	4,996	3.8	3.9
Colorado	672	738	4.1	4.6
Connecticut	516	467	2.8	2.6
Delaware	129	132	3.6	3.8
District of Columbia	76	73	2.5	2.5
Florida	2,660	2,498	4.5	4.5
Georgia	1,904	1,885	5.3	4.7
Hawaii	136	146	3.4	3.9
Idaho	349	348	6.5	6.6
Illinois	2,367	2,254	3.9	3.8
Indiana	1,605	1,555	4.1	4.2
Iowa	813	873	4.1	4.6
Kansas	623	666	4.1	4.6
Kentucky	1,117	1,093	4.6	4.7
Louisiana	1,156	1,161	6.0	6.2
Maine	247	258	3.6	3.8
Maryland	821	813	3.2	3.7
Massachusetts	1,010	991	3.4	3.3
Michigan	2,213	2,258	3.8	3.0
Minnesota	1,024	1,031	4.1	4.1
Mississippi	883	922	6.4	7.0
Missouri	1,448	1,474	4.7	5.0
Montana	323	395	5.8	7.3
Nebraska	433	485	3.9	4.5
Nevada	267	259	6.4	6.7
New Hampshire	145	179	2.8	3.5
New Jersey	1,355	1,314	2.8	2.8
New Mexico	636	587	6.7	6.6
New York	3,082	3,197	4.6	4.3
North Carolina	1,889	1.976	5.3	5.8
North Dakota	208	208	4.8	5.1
Ohio	2,342	2,451	3.6	3.9
Oklahoma	797	843	3.7	4.1
Oregon	635	734	4.0	4.8
Pennsylvania	2,223	2,352	3.3	3.5
Rhode Island	131	122	2.4	2.5
South Carolina	967	1,099	4.7	5.6
South Dakota	286	294	5.6	5.8
Tennessee	1,427	1,414	4.9	5.1
Texas	3,692	3,688	4.6	4.8
Utah	361	382	5.0	5.7
Vermont	154	151	4.7	4.7
Virginia	1,220	1,256	3.5	3.8
Washington	775	852	3.3	3.8
West Virginia	478	523	4.7	5.3
Wisconsin	1,156	1,168	4.0	4.2
Wyoming	192	197	5.6	5.8
Puerto Rico	568	550	7.5	8.2

*The mileage death rate is the number of deaths per 100,000 vehicle-miles

TABLE 4.2
MOTOR VEHICLE TRAFFIC DEATHS BY STATES (1982-83)

Source: National Safety Council

Place of Accidents	Number 1983	Number 1982	Mil. death rate* 1983	Mil. death rate* 1982	Place of Accidents	Number 1983	Number 1982	Mil. death rate* 1983	Mil. death rate* 1982
Total U.S.*	44,800	48,000	2.7	2.9	Montana	286	254	4.0	3.6
Alabama	940	845	3.2	3.1	Nebraska	255	261	2.1	2.2
Alaska	150	107	3.9	3.6	Nevada	252	280	3.8	4.2
Arizona	675	724	2.6	3.8	New Hampshire	181	173	2.6	2.6
Arkansas	554	550	3.2	3.2	New Jersey	932	1.061	1.7	2.0
California	4,571	4,609	2.6	2.8	New Mexico	535	575	4.3	4.9
Colorado	644	664	2.6	2.9	New York	2,077	2,147	2.5	2.7
Connecticut	445	521	2.1	1.7	North Carolina	1,240	1,320	2.8	3.1
Delaware	112	123	2.3	2.7	North Dakota	116	148	2.1	2.7
District of Columbia	65	36	1.8	1.1	Ohio	1,585	1,618	2.1	2.2
Florida	2,703	2,711	3.3	3.5	Oklahoma	853	1,064	2.7	3.6
Georgia	1.296	1,227	3.1	2.7	Oregon	548	518	2.7	2.6
Hawaii	139	161	2.2	2.7	Pennsylvania	1,751	1,648	2.4	2.5
Idaho	263	255	3.2	3.6	Rhode Island	100	109	1.6	1.9
Illinois	1,553	1,671	2.3	2.5	South Carolina	845	730	3.4	3.1
Indiana	1,016	964	2.5	2.4	South Dakota	174	148	2.6	2.4
Iowa	509	474	2.5	2.4	Tennessee	1,046	1.074	2.9	3.1
Kansas	411	496	2.2	2.8	Texas	3,823	4,271	3.0	3.5
Kentucky	709	836	3.0	3.3	Utah	283	296	2.5	2.7
Louisiana	942	1.093	4.3	4.3	Vermont	94	108	2.3	2.7
Maine	224	163	2.8	2.1	Virginia	900	881	2.1	2.3
Maryland	663	660	2.1	2.3	Washington	705	757	2.2	2.5
Massachusetts	643	655	1.7	1.8	West Virginia	427	452	4.4	4.3
Michigan	1,325	1.417	2.1	2.3	Wisconsin	735	775	2.2	2.3
Minnesota	558	581	1.8	2.0	Wyoming	173	201	3.2	3.8
Mississippi	716	728	4.1	4.2					
Missouri	921	906	2.5	2.5					

(a) Includes both traffic and nontraffic motor-vehicle deaths. (b) The mileage death rate is deaths per 100,000,000 vehicle miles 1983 mileage death rates are National Safety Council estimates.

IV.

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SAS 2.3

STATE AUTOMOBILE SPEED LIMITS
(Except Where Otherwise Posted)

Source: American Automobile Assn. Digest of Motor Laws 1973

Alabama: Interstate highways 70 mph daytime, 60 mph nighttime; open highways 60 mph daytime, 50 mph nighttime; residential districts 25 mph; business districts, school zones, etc. 15 mph.

Alaska: Divided highways 70 mph, state highways, surfaced 60 mph, unsurfaced 50 mph, city streets 30 mph.

Arizona: All highways 65 mph or as posted, residential areas, business districts 25 mph or as posted, school zones 15 mph.

Arkansas: Interstate and controlled access roads 75 mph, urban districts 30 mph.

California: Statewide limit 65 mph (except freeways posted for 70 mph), residential and business districts, school zones 25 mph.

Colorado: 4-lane highways 70 mph, open highways 60 mph, residential districts 30 mph, business districts 25 mph, open mountain highway 40 mph, winding mountain highway 20 mph.

Connecticut: Reasonable and proper for conditions. Posted limits prima facie evidence of reasonable speed; residential and business districts posted locally.

Delaware: Open highways, 4-lane, 60 mph, 2-lane, 50 mph; residential and business districts, 25 mph.

District of Columbia: Expressways 45 mph; school and playground areas 15 mph; other roads 25 mph.

Florida: Interstate highways 70 mph day, 65 mph night; open highway 65 mph day, 60 mph night; residential & business districts 30 mph.

Georgia: Interstate highways 70 mph daytime, 65 mph nighttime; open highway 60 mph daytime, 50 mph nighttime; residential, business and school areas 25 mph.

Hawaii: Open highways 45 mph, or as posted residential and business districts, local ordinances govern.

Idaho: Interstate highways 70 mph; open highway 60 mph daytime, 55 mph nighttime; urban and business districts 35 mph.

Illinois: Expressways 70 mph; open highways 65 mph; urban areas 30 mph; school zones 20 mph.

Montana: Open highways, day, reasonable and prudent unless posted, 55 mph night except Interstate highways 65 mph nights; residential and business districts 25 mph.

Nebraska: Interstate highways 75 mph; open highways 65 mph; residential districts 25 mph; business districts 20 mph; on non-hard surfaced roads 50 mph.

Nevada: Turnpike 70 mph; open highways 60 mph; rural residential districts 35 mph; urban and business districts 30 mph; school zones 20 mph.

New Hampshire: Turnpike 70 mph; open highways 60 mph; rural residential districts 35 mph; urban and business districts 30 mph; school zones 20 mph.

New Jersey: Turnpike 60 mph; open highway 50 mph; residential and business districts 25 mph.

Mew Mexico: Open highways 70 mph daytime, 60 mph nighttime; other highways 60 mph daytime, 50 mph nighttime; residential and business districts 25 mph; school zones 15 mph.

New York: New York State Thruway 65 mph; open highways 55 mph; school zones when children going to and from school as posted.

North Carolina: interstate 70 mph; open highways 65 or 60 mph, permitted as posted, otherwise 55 mph; residential districts 35 mph; business 20 mph.

Ohio: Turnpike and expressways 70 mph; open highways 60 mph daytime, 50 mph nighttime; within municipal corporations 25 mph; school zones 20 mph.

Oklahoma: Turnpikes and Interstate highways 70 mph; open highways 65 mph daytime, 55 mph nighttime; school zones 25 mph.

Oregon: Open highways 55 mph; freeways up to 75 mph; residential districts 25 mph; business and school zones 20 mph.

Pennsylvania: Turnpike 65 mph; open highways 55 mph; residential and business districts 15 to 40 mph.

IV.

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SAS 2.3a

Indiana: Interstate highways 70 mph; open highways 65 mph; residential district 30 mph; school zones as posted.

Iowa: Interstate limited access roads 75 mph daytime, 65 mph nighttime; open highways 70 mph daytime, 60 mph nighttime; suburban 45 mph; residential and school districts 25 mph; business districts 20 mph; secondary roads 60 mph daytime, 50 mh nighttime.

Kansas: Interstate highways 75 mph daytime, 70 nighttime; open highways 70 mph daytime, 60 mph nighttime; residential districts 30 mph; business districts 20 mph; Kansas Turnpike 75 mph, 40 mph minimum.

Kentucky: Interstate highways 70 mph; open highways 60 mph daytime, 50 mph nighttime; residential and business districts 35 mph.

Louisiana: Open highways 4-lane, 70 mph; other open highways 60 mph.

Maine: Turnpikes 70 mph daytime, 65 mph nighttime; open highways 45 mph; residential and business districts 25 mph.

Maryland: Interstate highways 70 mph; open country expressway 60 mph; dual lane highways 55 mph; other highways 50 mph; residential and business districts 30 mph; thinly settled areas 35 mph; other highways 30 mph.

Massachusetts: Turnpike 65 mph; divided highway 50 mph; other highways 40 mph; residential and business districts 30 mph; school zones 20 mph.

Michigan: Freeways 70 mph; open highways 65 mph daytime; 55 mph nighttime; residential 25 mph.

Minnesota: Open highways 65 mph daytime; 55 mph nighttime; all speeds in urbn districts 30 mph.

Mississippi: Interstate highways 70 mph; open highways 65 mph; residential districts 25 mph; business districts 20 mph; school zones 15 mph.

Missouri: Dual lane U.S. routes 70 mph; undivided U.S. routes 70 mph daytime; 65 mph nighttime; other open highways 65 mph daytime; 60 mph nighttime; municipalities 45 mph.

Rhode Island: Residential and business districts 25 mph; elsewhere 50 mh daytime, 45 mph nighttime.

South Carolina: Interstate Sytem 70 mph daytime, 65 mph night; State highways 60 mph daytime, 55 mph night; urban districts 30 mph.

South Dakota: Interstate highways 75 mph daytime, 70 mph nighttime; open highways 70 mph daytime, 60 mph nighttime; residential and business districts 30 mph; school zones 15 mph.

Tennessee: Open highways 65 mph day, 55 mph night; school zones 15 mph; Interstate highways 75 mph.

Texas: Federal or State roads 70 mph daytime, 65 mph nighttime; other rural roads 60 mph daytime, 55 mph nighttime; in urban districts 30 mph.

Utah: Open highways as posted; residential and business districts 25 mph; school zones 20 mph.

Vermont: Interstate highways 65 mph; open highways 50 mph.

Virginia: Interstate 70 mph; all others 55 mph or as posted; residential, business and school areas 25 mph.

Washington: County roads 50 mph; cities and towns 25 mph; school zones 20 mph; Interstate highways 70 mph; in other locations 60 mph.

West Virginia: Interstate highways, 70 mph; Turnpike 60 mph; open highways 55 mph; residential districts 25 mph; school zones 15 mph.

Wisconsin: Interstate highways 70 mph daytime, 60 mph nighttime; open highways 65 mph daytime, 55 mph nighttime; residential and business districts 25 mph; school zone 15 mph.

Wyoming: Open highways 4-lane divided, 75 mph; open highways 65 mph; residential districts 30 mph; business and school districts 20 mph.

Canal Zone: Outside town limits 40mph; within town limits 25mph.

Guam: Roads 45 mph; school zones when children at recess or going to and from school 10 mph.

Puerto Rico: Open highways 45 mph; urban districts and school zones 25 mph.

IV.

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SAS 2.4

Population of the U.S., 1970-1980

Region, division, and state	1980 Census	1970 Census
United States	226,504,826	203,236,298
Regions:		
Northeast	49,136.667	49,050,525
North Central	58,853,803	56,577,067
South	75,349,156	62,796,347
West	43,165,199	34,809,350
New England	12,348,483	11,847,196
Maine	1,124,660	993,663
New Hampshire	920,610	737,661
Vermont	511,456	444,732
Massachusetts	5,737,037	5,689,170
Rhode Island	947,154	949,723
Connecticut	3,107,576	3,032,217
Middle Atlantic	36,706,174	37,203,330
New York	17,557,268	18,241,266
New Jersey	7,557,268	7,168,164
Pennsylvania	11,866,728	11,793,909
East North Central	41,668,738	40,252,678
Ohio	10,797,419	10,652,017
Indiana	5,490,179	5,156,392
Illinois	11,418,461	11,113,976
Michigan	9,258,344	8,875,083
Wisconsin	4,706,336	4,417,933
West North Central	17,184,066	16,324,300
Minnesota	4,077,148	3,805,069
Iowa	2,913,387	2,825,041
Missouri	4,917,444	4,677,399
North Dakota	652,695	617,761
South Dakota	690,178	666,257
Nebraska	1,570,006	1,483,791
Kansas	2,363,208	2,249,071
South Atlantic	36,943,130	30,671,337
Delaware	595,225	548,104
Maryland	4,216,446	3,922,399
District of Columbia	637,661	756,510
Virginia	5,348,279	4,648,494
West Virginia	1,949,644	1,744,237
North Carolina	5,874,429	5,082,050
South Carolina	3,119,208	2,590,516
Georgia	5,464,266	4,589,575
Florida	9,739,992	6,789,443
East South Central	14,062,881	12,804,562
Kentucky	3,661,433	3,219,311
Tennessee	4,590,750	3,924,164
Alabama	3,890,061	3,444,165
Mississippi	2,520,638	2,216,912
West South Central	23,743,134	19,322,458
Arkansas	2,285,513	1,923,296
Louisiana	4,203,972	3,643,180
Oklahoma	3,025,266	2,559,253
Texas	14,226,363	11,196,730

IV.

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SAS 2.4

Population of the U.S., 1970-1980 - page 2

Mountain	11,368,330	8,283,596
Montana	786,690	694,408
Idaho	943,936	713,008
Wyoming	470,816	332,416
Colorado	2,888,834	2,207,250
New Mexico	1,299,968	1,016,000
Arizona	2,717,006	1,772,482
Utah	1,461,037	1,059,273
Nevada	798,184	488,730
Pacific	31,796,100	26 ,525,774
Washington	4,130,163	3,409,100
Oregon	2,632,063	2,091,365
California	23,668,562	19,963,134
Alaska	400,481	302,173
Hawaii	965,000	769,913
Puerto Rico	3,196,520	2,712,083

IV.

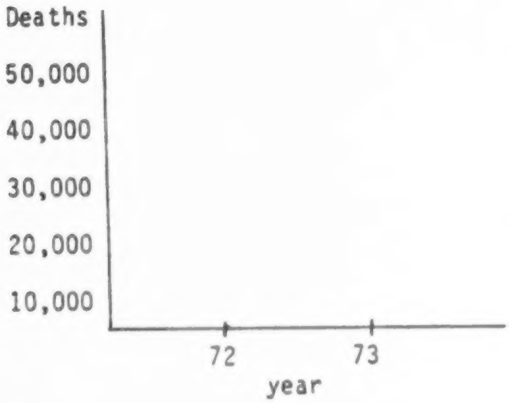
QUESTIONS

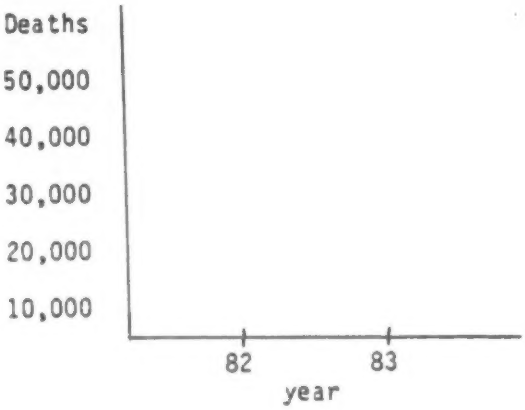
1. Before the mandatory 55 m.p.h. speed limit did speed limits vary from state to state? Give examples.

2. What factors influenced the speed limit of each state?

3. Locate the states on the map and determine regions. What is the correlation between region and speed limit?

Construct two graphs, one of a ten year period before mandatory 55 MPH and one of a ten year period after, graph fatalities per year and compare (see Below)



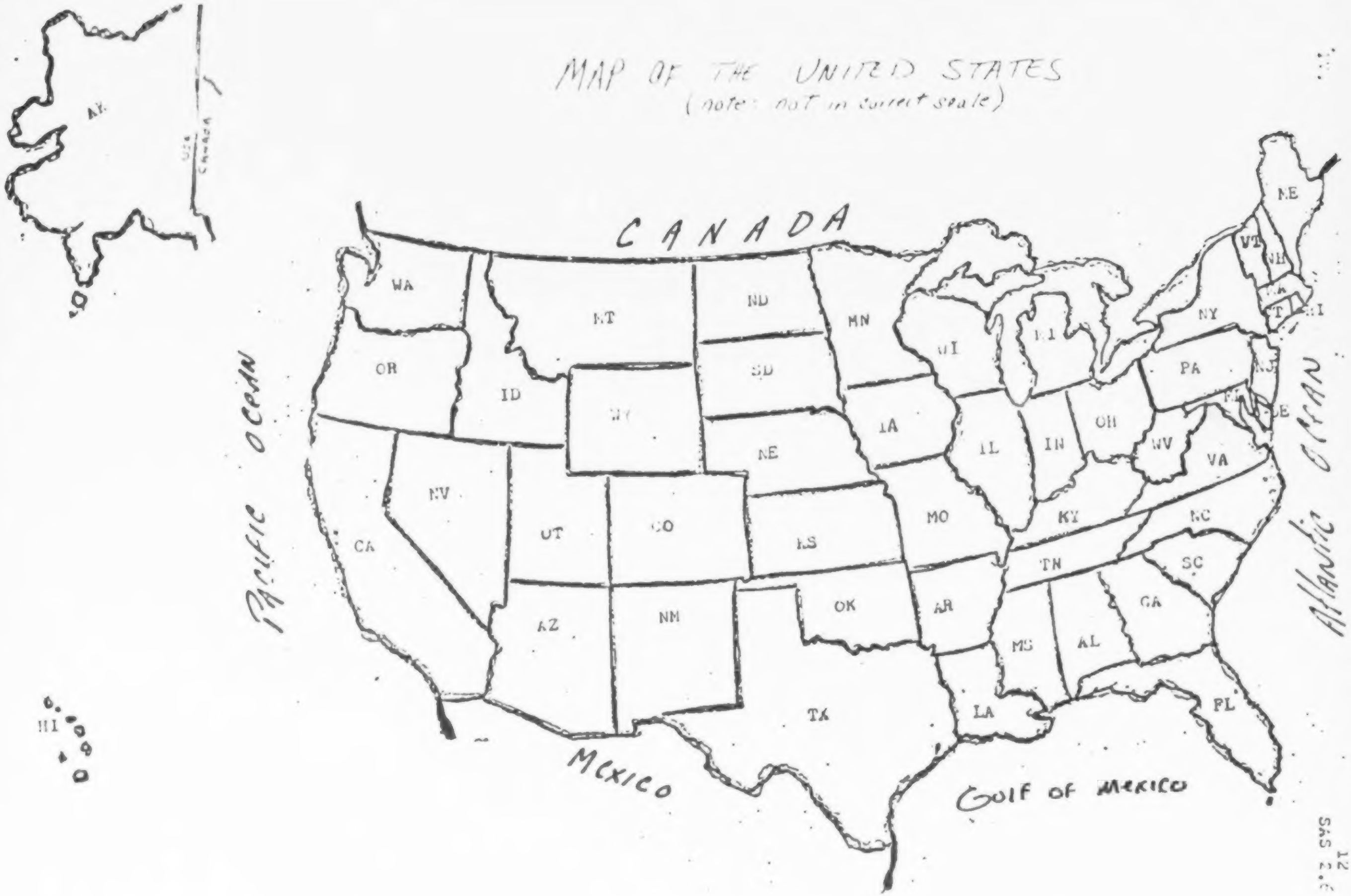


4. Was there a decrease in fatalities from 1973 to 1983 in each state?

5. The 55 m.p.h. speed limit was put into law to save fuel. Has it accomplished anything else?

6. What do you feel about states rather the Federal Government establishing their own speed limits as in the past?

MAP OF THE UNITED STATES
(note: not in correct scale)


AK
USA
CANADA
CANADA
WA
MT
ND
MN
ME
VT
NH
MA
CT
RI
NY
OR
ID
SD
WI
MI
PA
NJ
WY
IA
OH
MD
DE
NE
IL
IN
WV
VA
NV
CA
UT
CO
KS
MO
KY
NC
TN
SC
OK
AR
GA
AZ
NM
MS
AL
TX
LA
FL
Pacific Ocean
Atlantic Ocean
Mexico
Gulf of Mexico
HI

SAS 2.6
12

ACTIVITY 3: Fuel Consumption and the Speed Limit

Objectives: The students should be able to:

1. analyze data concerning fuel consumption and speed.
2. identify the major factors affecting fuel consumption at different speeds.
3. evaluate positive and negative aspects of the 55 MPH speed limit.

Teacher Background: No additional information needed.

Materials: Pen and Paper

Student Activity Sheets:

SAS 3.1	History of Cars and Speed
SAS 3.2	Effect of Speed on Fuel Consumption Rates Automobile
SAS 3.3	Questions

Suggested Procedures: Read SAS 3.1 on history of cars and speed. After this take a vote on weather fuel is saved by driving at 55 MPH as opposed to 70 MPH? Put results on board, use data table (see SAS 3.2) to answer the questions on the student activity sheet. Discuss answers with the rest of the class. After discussion take poll again.

IV.

History of Cars and Speed

The first automobile in the United States was driven in 1893. Almost immediatley, design set out to see how fast he could make it go. By 1894, people were talking about an automobile race. The first race took place one year later in Chicago. It was a 52 mile race with the winner averaging 5.05 MPH.

By 1900, when cars were first produced in any large quantity, 10 MPH was considered a reasonable speed on the open road. In 1901, New York and Connecticut passed the first motor vehicle speed limit laws in the United States. The speed limits were 8 MPH in the cities and 15 MPH on the open road. These laws also contained a provision that a motorist, upon meeting a horse, must pull to the side of the road and, if necessary turn off the motor to allow the horse to pass. These early speed laws were passed mainly to pacify the non-motorists who complained of the noise and dust as opposed to modern day speed limits that are designed to protect the motorist from himself and from other motorists. Now, of course, speed limits are imposed to conserve fuel, too.

From the very early car speeds of 5 MPH, cars quickly became capable of higher speeds. In 1904, Henry Ford set a world's land speed record of over 93 MPH! By this time, highway speeds were about 15 MPH, mostly because the road system was not designed or constructed for automobile traffic. They were more suitable for horse and buggy travel. Very few paved roads existed. However, road construction for automobile traffic began about 1900 and has continued until the present time. Speed and speed limits continued to increase as a network of paved roads grew across the nation.

- Department of Transportation

14a

SAS 3.2

IV. Effect of Speed on Fuel Consumption Rates

Automobiles

Test Car Number and Net Weight (lbs.)	Miles Per Gallon At Selected Speeds				
	35	45	55	65	75
1 (4,880)	17.12	17.20	16.11	14.92	13.13
2 (3,500)	19.30	18.89	17.29	15.67	13.32
2A (3,500)	21.33	21.33	18.94	17.40	15.36
3 (3,540)	23.67	24.59	20.46	14.83	13.42
4 (3,975)	18.25	20.00	16.32	15.77	13.61
5 (2,450)	31.45	35.19	33.05	30.78	22.82
6 (3,820)	22.88	19.41	20.28	17.78	14.88
7 (3,990)	15.61	14.89	16.98	13.67	11.08
8[1] (2,050)	(24.79)	(27.22)	(26.80)	(24.11)	N.A.
9 (2,290)	21.55	20.07	19.11	17.83	16.72
10 (2,400)	22.72	21.94	22.22	21.08	17.21
11 (5,250)	18.33	19.28	15.62	14.22	12.74
12 (4,530)	20.33	20.00	17.50	16.17	14.86
Average (Unweighted)	21.05	21.07	19.49	17.51	14.93

---

[1] Since vehicle #8 could not be operated satisfactorily at 75 miles per hour, its miles per gallon performances were omitted from the averages. They are, however, given in parentheses.

IV.

Questions

1. Do many cars get more miles per gallon at 35 mph than at other speeds?

2. Do many cars get more miles get per gallon at 45 mph than at other speeds (identify the test car number)?

3. Do any cars get their best milage at 55 mph (identify the test car number)?

4. Do any of these cars get more miles per gallon at speeds of 65 or 75 mph than at other speeds? (Identify the test car number.)

5. Using cars 10, 11 and 12 which car gets the best mileage at 35 mph? 45? 55? 65? 75? Which car get the least mileage at these speeds?

6. Give possible reasons why vehicle #8 could not be operated satisfactorily at 75 mph.

7. List some negative aspects of the 55 mph speed limit.

8. Would it be reasonable to set a speed limit at 35 mph? Why?

9. What effect has the speed limit on natural resources?

10. Of the cars offered which one would you buy?

Activity 4.

Do Seatbelts and Other Safety Devices Prevent Injury and Death?

Objectives: The students should be able to:

1. make their own decisions concerning the effectiveness of seat belts and other safety devices.
2. analyze data concerning accidental deaths.

Materials:

Equipment designated by the lab sheet.
Pencil
Paper
Graph paper

Student Activity Sheets:

SAS 4.1	Lab sheet - Testing Automobie Safety Devices
SAS 4.2	Lab sheet - Questions
SAS 4.3	Accidental Death Data
SAS 4.4	Questions

Suggested Procedures:

1. Lab procedure for determining the effectiveness of seat belts and other safety devices.
2. Using data sheet 4.3, graph and answer questions.

Supplementary Materials:

1. Bureau of Safety Programming and Analysis
109 Transportation and Safety Building
Harrisburg, PA 17120

Booklets

*Buckle Up Baby
*Safety Belt Roulette
*Speed Limits Life

2. National Highway Traffic Safety Administration
General Services Division
400 Seventh ST., S.W.
Washington, DC 20590

Booklets

*Alcohol, Drugs, and Young Drivers
*55 - Judge for Yourself
*There are lots of safety belt myths - why not consider the truths

IV. SAS 4.1

Automobile Safety Devices

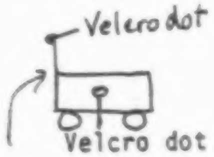
Purpose: To show the effectiveness of various automobile safety devices.

Apparatus:

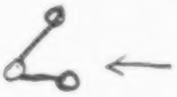
Hall's carriage modified with wood back and Velcro dots
Clay figure
Shoestring seat belt
Cork head rest,
Balloon air bag
ramp for launching cart (Use ramp from Module III, Activity 5)

Diagrams

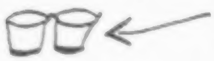
1 Cart


Velcro dot
Velcro dot
wood strips glued to back

2 seat belt


shoestring
Velcro dot

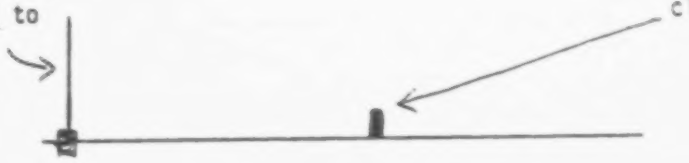
3 cork head rest


split cork rubber band to top of wooden back

4 clay figures

1 stick modeling clay

Total set up


Ramp on rod clamped to table
stopping board clamped to table

Procedure:

1. Place the clay figure in the cart according to the instructions for each trial in the data table below.
2. Place cart on the ramp at the same starting point for each trial and allow the cart to roll down the ramp and strike the board.
3. Describe the damage done to the clay figure as to head, arms and legs, and trunk.

IV. SAS 4.1

Date Table Trial	Description of Damage
1 no safety devices	
2 seat belt only	
3 seat belt and head rest	
4 seat belt, head rest, and air bag	

IV. SAS 4.2

Questions relative to lab

1. What was the reason for starting the cart from the same height each trial?

2. In which trial was the passenger most injured. Why?

3. In which trial was the passenger the least injured. Why?

4. Give reasons for making the use of seat belts and air bags manadatory.

5. What are the arguments or NOT making seat belt use and air bags mandatory?

IV. SAS 4.3

Accidental Death Data Sheet

Table 1

Accidental Deaths by Age, Sex, and Type in 1980

(National Safety Council)

Age Group	Total Accidental Deaths	Motor Vehicles	Falls	Drownings	Fires/ Burns	Poison
0 - 4	4479	1426	155	803	846	73
5 - 14	5524	2747	89	856	478	33
15 - 24	26204	19040	515	278	564	522
25 - 44	26772	16133	1066	1858	1017	1372
45 - 64	18140	8022	2116	902	1245	650
65 - 74	8997	2991	18040	307	749	218
75+	15950	2813	7513	253	923	221

Table 2
Percentage of Accidental Deaths Caused by Motor Vehicles (National Safety Council)

Age Group	Motor Vehicles Deaths (total)	Motor Vehicles Deaths (as a % of all accidental deaths)
0 - 4	1426	31.8%
5 - 14	2747	52.6%
15 - 24	19040	72.7%
25 - 44	16133	60.3%
45 - 64	8022	44.2%
65 - 74	2991	33.0%
75+	2813	17.6%

*Note: 150,000 people were permanently disabled in car accidents in 1983. (National Safety Council).

Accidental Death Data Sheet

Procedure:

1. Use Table 1 to make Bar Graph 1 placing Total Accidental Deaths (for each age group) on the vertical axis and Age Group on the horizontal axis.
2. Use Table 1 to make Bar Graph 2 placing Motor Vehicle Deaths (for each age group) on the vertical axis and Age Group on the horizontal axis.
3. Use Table 2 to make Bar Graph 3 placing Motor Vehicle Deaths as a Per cent of all Accidental Deaths (for each age group) on the vertical axis and Age Group on the horizontal axis.

IV.

Accidental Death Questions

1. What age group has the most total accidental deaths? Which has the least? Can you give some possible reasons why?

2. Which age group has the most accidental deaths caused by motor vehicles? Which group has the least? Can you give some possible reasons why?

3. Use Table 1 to determine the type of accident that causes the most deaths for each age group. How does your answer relate to great concern for seat belt use in this country?

4. Seat belts greatly increase your chance of surviving a bad car accident. You are 60% less likely to receive serious or fatal injuries if you wear a seat belt. Why is seat belt use important to your age group? Use Graph 3 to help in forming an answer.

5. Child restraint laws, particularly for those younger than 4 years of age have received much publicity lately. Use Table 1 or Table 2 to explain why this makes sense. How must youngsters less than age 4 be protected while riding in a car in Allegheny County?

PITTSBURGH STS PROJECT

TEACHER EVALUATION FORM

Name ______________________

School ______________________

Grade Level ______________________

Module: Intro A 1 2 3 4
(circle one)

Activity Title & Number ______________________

Please ANSWER EACH OF THE FOLLOWING QUESTIONS AT THE COMPLETION OF EACH ACTIVITY. Please comment in more detail on separate pages of paper where appropriate. Circle the most appropriate response.

1. OBJECTIVES

Were the stated objectives clear and accurate? Excellent Good Poor

2. TEACHER BACKGROUND

Was the teacher background accurate? Excellent Good Poor

Was the information provided a sufficient background on the subject? Excellent Good Poor

3. MATERIALS

Was the materials list complete? Excellent Good Poor

Did you have enough of each material required? Excellent Good Poor

*Please indicate any resources, books (teacher or student), equipment, etc. that your recommend for inclusion in future modules.

4. STUDENT ACTIVITY SHEETS

Were the Student Activity Sheets (SAS):

Relevant to the objectives? Excellent Good Poor

Clear and logical? Excellent Good Poor

*Which were the most successful activities?

5. EXTENDED ACTIVITIES

*Have newly acquired decision making skills lead to action on personal problems? Involvement in community organizations? Involvement in local government issues? Other?

6. EVALUATION

What method of student evaluation did you use? (SAS sheet, separate test, etc.?)

*How successful were the students?

7. PROCEDURE

Was the suggested procedure clear and complete? Excellent Good Poor

*Did you follow the suggested procedure? What modifications, if any, did you make?

8. RATE THE FOLLOWING: (circle one)

Student interest	High	Medium	Low
Appropriateness of material for students	High	Medium	Low

9. Do you recommend this activity for future use?

10. Other comments/recommendations:

Teacher signature ______________________ Date ________

Date when Activity was completed ______________________